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Overcoating of Lead-Based Paint on Steel Structures

Cost and Performance Report

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Executive Summary

In the past, hazardous lead-based paint (LBP) has been used extensively on all types of Department of Defense (DoD) steel structures and steel components including road and rail bridges, transmission towers, antennae, storage tanks, metal buildings, and aircraft hangars.

The removal of LBP is generally performed by abrasive blasting or by water jetting. Containment and disposal of surface preparation debris, worker protection, and other regulatory compliance costs combine to make removal of LBP very expensive. According to a recent Federal Highway Administration report (FHWA 1995), bridge maintenance painting costs have nearly doubled over the past 5 years. The added costs for worker health, environmental monitoring, waste disposal, and containment are significant.

This Environmental Security Technology Certification Program (ESTCP) project demonstrated the overcoating process, which may be defined as the practice of painting over existing coatings as a means of extending service life. Maintenance painting of this type does not require extensive surface preparation and minimizes worker exposures and hazardous waste generation.

Demonstration of the overcoat process was performed during 2000 on a water tank at Fort Campbell, KY and a railroad bridge at Holston Army Ammunition Plant (HAAP), Kingsport, TN. The demonstrations met the performance requirements, which were to: (1) clean and overcoat the existing LBP, (2) comply with environmental standards, (3) comply with worker health and occupational safety requirements, (4) collect data and estimate installed costs, and (5) determine the performance of the overcoat process.

The installed cost of overcoating on a simple structure (Fort Campbell water tank) was estimated at \$1.55/sq ft. The installed cost for overcoating on a complex structure (HAAP railroad bridge) was estimated at \$2.83/sq ft. By comparison, the cost of deleading and installing a new paint system is \$5 to \$18/sq ft with an average cost of \$8/sq ft.

The hazardous wastes generated during preparation for overcoating of the simple and complex structures were 0.18 kg per and 6.87 kg per 1,000 sq ft, respectively.

By comparison, complete coating removal by abrasive blasting with expendable coal slag abrasive would produce approximately 6,800 kg of hazardous waste per 100 sq ft.

Overcoating offers the benefit of maximizing the economic life of existing LBP coatings while minimizing present expenditures and reducing worker exposure and hazardous waste generation.

Preface

This technology demonstration was conducted for Headquarters, Department of the Army under Program Element (PE) 063728A, “Environmental Technology Demonstration”; Project 002, “Environmental Compliance Technology”; Work Unit CF-M B101, “Cost Effective Technologies to Reduce, Characterize, Dispose, or Reuse Sources of Lead Hazards.” Part of this work was accomplished with funds provided by U.S. Army Forces Command under Military Interdepartmental Purchase Requests MIPR0BJECCEN04 and MIPR0DJ7CDEN35. The technical monitor was Bryan Nix (ACSIM-FSF).

The work was performed by the Materials and Structures Branch (CF-M) of the Facilities Division (CF), Construction Engineering Research Laboratory (CERL). The CERL Principal Investigator was Dr. Ashok Kumar. Part of this work was done by Tim Race, Corrosion Control Consultants and Laboratories, under contract no. DACA42-002-P-0274 and DACA42-00-D-0002. The technical editor was Linda L. Wheatley, Information Technology Laboratory – Champaign. Martin J. Savoie is Chief, CF-M, and L. Michael Golish is Chief, CF. The Technical Director of the Installation Operations Business Area is Gary W. Schanche (CV-T), and the Director of CERL is Dr. Alan W. Moore.

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1 Introduction

Background

In the past, hazardous lead-based paint (LBP) has been used extensively on all types of Department of Defense (DoD) steel structures and steel components including road and rail bridges, transmission towers, antennae, storage tanks, metal buildings, and aircraft hangars. The removal of LBP is generally performed by abrasive blasting or by water jetting. Containment and disposal of surface preparation debris, worker protection, and other regulatory compliance costs combine to make removal of LBP very expensive. According to a recent Federal Highway Administration report (FHWA 1995), bridge maintenance painting costs have nearly doubled over the past 5 years. The added costs for worker health, environmental monitoring, waste disposal, and containment are significant.

As an alternative to removing the LBP, overcoating is the practice of painting over existing coatings as a means of extending service life. Maintenance painting of this type does not require extensive surface preparation and minimizes worker exposures and hazardous waste generation. The Environmental Security Technology Certification Program (ESTCP) project reported here demonstrated the overcoating process.

Objectives

The objective of these demonstrations were to: (1) clean and overcoat the existing LBP, (2) comply with environmental standards, (3) comply with worker health and occupational safety requirements, (4) collect data and estimate installed costs, and (5) determine the performance of the overcoat process.

Approach

Demonstration of the overcoat process was performed during 2000 on a water tank at Fort Campbell, KY, and a railroad bridge at Holston Army Ammunition Plant (HAAP), Kingsport, TN.

Mode of Technology Transfer

Technology transfer is being accomplished by: (1) Technology Transfer Implementation Plan through the U.S. Army Environmental Center (AEC); (2) PWTB 420-70-2 "Installation Lead Hazard Management;" (3) participation in User Groups and Committees such as the Army Lead and Asbestos Hazard Management Team, Federal Lead-based Paint Committee Meetings at EPA or HUD, and ASTM D01.46 (Industrial and Protective Coatings) Committee; (4) websites maintained by the Army Assistant Chief of Staff for Installation Management (ACSIM) [<http://www.hqda.army.mil/acsimweb/fd/policy/facengcur.htm>], AEC [<http://aec.army.mil/usaec/>], and the U.S. Army Engineer Research and Development Center/Construction Engineering Research Laboratory (ERDC/CERL) [<http://www.cecer.army.mil>], as well as the Hands-on-Skills-Training (HOST) website at <http://www.hqda.army.mil/acsimweb/fd/policy/host/index.htm>; (5) demonstration/validation of emerging technologies through Army demonstration funding (6.3) starting in Fiscal Year 2000 (FY00) and continuing through FY03, and cost/performance reports resulting from those demonstrations.

Units of Weight and Measure

U.S. standard units of measure are used throughout this report. A table of conversion factors for Standard International (SI) units is provided below.

SI conversion factors		
1 in.	=	2.54 cm
1 ft	=	0.305 m
1 sq ft	=	0.093 m ²
1 gal	=	3.78 L
1 lb	=	0.453 kg
°F	=	(°C x 1.8) + 32

2 Technology Description

Technology Application and Process Description

Overcoating does not require extensive surface preparation. Surfaces to be overcoated may be low-pressure power washed or hand washed using a mild detergent and water solution. Wash water should be collected and tested, however, to ensure that it does not meet the hazardous criteria for lead, which typically it will not. The washed surfaces are then further prepared by spot cleaning rusted areas with power or hand tools. Vacuum-assisted power tools can be used to collect the debris and reduce worker exposure. Ground tarpaulins (tarps) should also be used to collect any falling debris. The cleaned surfaces should receive a final cleaning using either solvent or water to remove any adherent dust. The clean dry surfaces are then overcoated using an appropriate coating. Overcoat materials are usually applied as systems of two to three coats.

Health and safety requirements are the same as for other industrial maintenance painting projects, including fall protection, flammable liquids, hearing conservation, eye protection, and respiratory protection. Additional requirements may be necessary depending on whether workers are exposed to lead above the action level during surface preparation activities. Half-face respirators with an Assigned Protection Factor (APF) of 10 are recommended for use during cleaning with vacuum-assisted power tools. A greater degree of respiratory protection may be required if vacuum assist is not used. Personal air monitoring (PAM) should be conducted at the outset of any project involving the removal of LBP to ensure that workers are adequately protected.

The purpose of overcoating is to maximize the economic life of the existing LBP by deferring deleading, which is very expensive. The overcoated LBP does not last as long as a new high performance coating system applied to a well-prepared blast cleaned surface. However, the installed cost of overcoating is low compared to deleading, and life cycle cost analyses generally show overcoating to be more cost effective for atmospheric exposures in mild and moderately corrosive atmospheres.

The technology is applicable to all types of DoD steel structures and steel components including pedestrian, vehicular, and rail bridges; exteriors of water tanks and

tanks storing petroleum, oils, and lubricants (POL), metal buildings, transmission towers, antennae, aircraft hangars, and maintenance facilities.

Advantages and Limitations of the Technology

The removal of hazardous coatings is generally performed by abrasive blasting or by water jetting, but containment and disposal of surface preparation debris, worker protection, and other regulatory compliance costs make removal of hazardous paints very expensive. Bridge maintenance painting costs have nearly doubled over the past 5 years (FHWA 1995). Typical bridge maintenance painting contracts involving complete coating removal and repainting averaged \$5.05/sq ft for nonhazardous coatings and \$10.60/sq ft for hazardous paint removal. The added costs for worker health, environmental monitoring, waste disposal, and containment are significant. The FHWA study concluded that, for mild service environments, overcoating is more cost effective than other maintenance options on a life cycle cost basis. They report an average equivalent annual cost of \$1.04/sq ft for overcoating using a 3-coat alkyd system versus \$1.99/sq ft for total removal and repainting with an inorganic zinc/epoxy/polyurethane system.

Overcoating is performed with a significant degree of risk, which refers to the chance that the overcoated system may either fail catastrophically or will not provide the desired period of protection. The applicability of overcoating is limited by the condition of the existing coating and underlying substrate and the severity of the exposure environment. If the existing coating is too thick, brittle, or poorly adherent, then overcoating should not be performed. If the degree of substrate corrosion is significant, then the level of effort needed to prepare the substrate may indicate that overcoating is not economically viable. Overcoating systems generally are not recommended for more severe exposure environments because deleading and paint replacement lasts significantly longer than overcoating and is more cost effective.

3 Demonstration Design

Performance Objectives

The performance objectives for these demonstrations were to:

- clean and overcoat the existing LBP,
- comply with environmental standards,
- comply with worker health and occupational safety requirements,
- collect data and estimate installed costs, and
- determine the performance of the overcoat process.

Selection of Test Sites

Two test sites were selected. The deluge water tank at Fort Campbell was chosen because it is representative of a simple structure. The tank is welded and does not have any irregular surfaces or complicated geometry. The HAAP railroad bridge was selected as a representative complex steel structure. The design contains complicated shapes such as back-to-back angles and rivet heads. Both sites were selected because of their northern climes with winter and summer temperature extremes, which can influence the performance of overcoating. Overcoat surfaces were selected to present a range of solar orientations, which may also influence the performance of the overcoat system.

Test Site Characteristics

Deluge tank number 7151 is near the corners of Blacksheep Run and C Avenue adjacent to Hangar Complex 4, Fort Campbell, KY. The tank is approximately 22 ft tall. Chicago Bridge and Iron Company constructed the tank in 1960. The existing LBP system was TT-P-86 Type I, Red Lead Linseed Oil Primer and TT-P-38 Aluminum Pigmented Tung Oil Phenolic Coating. Figure 1 shows the tank prior to cleaning and overcoating.

A visual inspection and physical tests were performed on the existing aged coating. Dry film thicknesses (DFTs) were measured at eight locations. The average thickness ranged from 2.0 to 4.1 mils. The overall average thickness is approximately 3.0 mils. Three adhesion measurements were taken, two with a south solar orientation and one with a north solar orientation. Crosscut adhesion values (ASTM D 3359 Method A) were 3A and 5A (south facing) and 3A (north facing), indicating slightly degraded intercoat adhesion.

Rusting ranged from 3 to 5 percent of the tank surface. Corrosion was primarily general spot corrosion with associated staining. The north side and lower portions of the tank were somewhat more degraded than the upper portions and south side. However, the rust distribution was fairly uniform overall.

Based on the generally low DFT and overall appearance, the tank has probably never been maintained or recoated.



Figure 1. Fort Campbell water tank prior to cleaning and overcoating.

Bridge 29 at HAAP is an active railroad bridge. The bridge was originally fabricated in the 1890s and moved to HAAP in about 1943 during the construction of the plant. The bridge is a multi-span through truss-type steel bridge with riveted connections and built-up beams. The piers are concrete. Welded pipe hangers support pipes conveying wastewater and chemicals. The bridge traverses a branch of the Holston River and is almost entirely over water. Figure 2 shows the railroad bridge with overcoated test areas.

A visual inspection and physical tests were performed on the aged coating. The bridge appears to have been touched up and repainted on numerous occasions. It is doubtful that the bridge has been abrasive blasted and painted in at least the last 30 years and possibly not since it was erected at HAAP in 1943. The paint system is comprised of an orange primer and aluminum topcoat, which are probably TT-P-86, Type I, red lead in linseed oil and TT-P-38, aluminum phenolic finish coat. Most of the touchup painting was done with an aluminum finish coat. Paint film thicknesses are generally 8 to 15 mils on flat vertical surfaces and 20 to 25 mils on upward facing horizontal surfaces. The amount of visible rust is less than 1 percent of the total test area. Most of the rust was on the tops of flanges. Some rusted areas on the flanges were previously coated over and were lifting and curled. Adhesion tests were performed in accordance with ASTM D 3359 Method A X-cut tape test. Adhesion ranged from 4A to 5A. In some cases, a thin layer of aluminum pigment was lifted with the tape. This nonadherent material is the equivalent of chalk in a standard pigmented coating. A good deal of dirt had also accumulated on many of the bridge components.



Figure 2. Railroad bridge at HAAP, TN, with overcoated test areas.

Physical Setup and Operation

Fort Campbell Water Tank

The structure was accessed using stepladders, painting poles, and platform scaffolds. Ground surfaces adjacent to the tank were covered with water impermeable tarpaulins. The tarps were taped to the base of the tank.

Cleaning was performed with an aqueous mixture of soap (100 to 1 dilution, Kleenz-Brite Extra, manufactured by Lad Chemicals, Inc., for James A. Lytle, Inc.). Cleaning solution was applied by sponge, and the surface was scrubbed with nonwoven abrasive pads attached to wood backup holders. Washed surfaces were rinsed with clean water using sponges and dried with clean clothes. Wash and rinse water were collected on ground tarps.

Loose paint and rust were removed in accordance with SSPC-SP 3 Power Tool Cleaning using two rotary cleaning tools equipped with 3M brand Clean and Strip pads. Waste was collected in a High Efficiency Particulate Air (HEPA) filter vacuum canister. Solvent wiping with clean rags and varnish makers and paint (VM&P) naphtha was performed to remove residual dust and contaminants.

Wasser Mio Aluminum primer, Ferromastic intermediate, and Ferrox A topcoat were applied by brush and roller to the first test area. Sherwin-Williams Corothane I Mastic primer, Corothane I Ironox A intermediate, and Corothane I Ironox A topcoat were applied by brush and roller to the second test area. Figure 3 shows the deluge tank after overcoating with test patches of moisture cure polyurethane.

All equipment, ground tarps, and debris were removed from the site. Wash and rinse water collected on the tarps was vacuumed and containerized.

HAAP Railroad Bridge

The structure was rigged using a combination of scaffolding, picks, and hanging stages. Access to the scaffold tower and staging was by ladder. Placement of the scaffold tower and staging was facilitated by use of a single-person lift bucket. The lift bucket was also used to access portions of the work surface. Ground surfaces below the bridge were covered with water-impermeable tarpaulins.

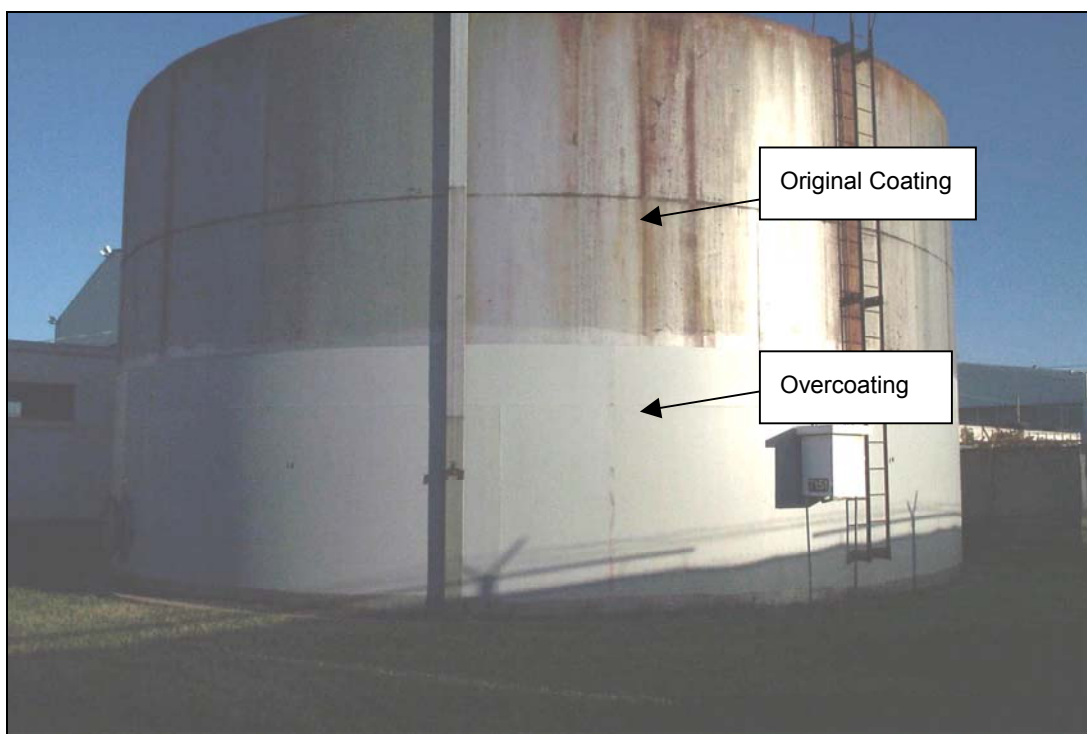


Figure 3. Deluge tank at Fort Campbell Army Airfield. (Original coating with lead-based paint primer visible at top is deteriorated and steel underneath is rusted. The tank was overcoated with test patches of moisture cure polyurethane in October 2000.)

Cleaning was performed with an aqueous mixture of household bleach (100 to 1 dilution) and soap (1000 to 1 dilution, Kleenz-Brite Extra). Cleaning solution was applied by sponge and the surface was scrubbed with 3-M Scotch Brite pads. Washed surfaces were rinsed with clean water using sponges and dried with clean cloths. Wash and rinse water were collected on the ground tarps.

Loose paint and rust were removed in accordance with SSPC-SP 3 Power Tool Cleaning using a vacuum-shrouded needle gun with 2-mm diameter needles. Waste was collected in a HEPA vacuum canister. Solvent wiping with clean rags and VM&P naphtha was performed to remove residual dust and contaminants.

Power tool cleaned areas were primed with SSPC Paint 25 using a natural bristle brush followed by two coats of TT-P-38E applied by brush and roller over the entire test area. The second test area was coated with two full coats of Wasser MC-Aluminum applied by brush and roller.

All rigging was removed at the completion of painting. Ground tarps and all debris were removed from the site.

Monitoring Procedures

Ambient and surface temperatures as well as relative humidity were monitored during coating application. Dry time and degree of dryness prior to recoating were assessed. Wet and dry film thicknesses (WFTs/DFTs) were measured. The appearance of the applied coatings was noted. Total surface area that was cleaned with power tools and coated were estimated. Personal air monitoring (PAM) was conducted on the power tool operator to determine lead exposure. Total lead and Toxicity Characteristic Leaching Procedure (TCLP) lead were determined on liquid and solid wastes. Waste quantities were measured. An inspection was performed 6 months after application to assess the performance of the overcoat systems. Corrosion and adhesion were evaluated.

Analytical Procedures

The personal air samples were analyzed for lead according to National Institute for Occupational Safety and Health (NIOSH) Method 7300. The respirable dust level was measured by NIOSH Method 600. TCLP was performed in accordance with U.S. Environmental Protection Agency (EPA) Method 1311.

4 Performance Assessment

Performance Data

Fort Campbell Water Tank

Approximately 5 percent of the total test area was power-tool cleaned.

The average WFT of the Wasser Mio Aluminum primer was 3.3 mils. The average DFT was 2.0 mils. The air temperature at the time of application was 73 °F and the surface temperature was 67.5 °F. The Ferromastic intermediate coat was applied after a drying period of 19 hours. The average WFT was 4.3 mils. The average DFT was 2.6 mils. The air temperature at the time of application was 70 °F and the surface temperature was 68.5 °F. The Ferrox A topcoat was applied after a drying period of 22 hours. The average WFT was 4.6 mils. The average DFT was 2.8 mils. The air temperature at the time of application was 65 °F and the surface temperature was 65 °F. The average DFT for the complete overcoat system was 7.4 mils.

The Corothane I Mastic primer for the second test area was applied to an average WFT of 3.6 mils. The average DFT was 2.2 mils. The air temperature at the time of application was 73 °F and the surface temperature was 67.5 °F. The Corothane I Ironox A intermediate coat was applied after a drying period of 19 hours. The average WFT was 3.6 mils. The average DFT was 2.0 mils. The air temperature at the time of application was 70 °F and the surface temperature was 68.5 °F. The Corothane I Ironox A topcoat was applied after a drying period of 28 hours. The average WFT was 3.6 mils. The average DFT was 2.0 mils. The air temperature at the time of application was 65 °F and the surface temperature was 65 °F. The average DFT for the complete overcoat system was 6.2 mils.

Waste minimization was accomplished by hand washing rather than power washing the existing coating. Wastewater was collected from the tarps, weighed, and tested for total lead and TCLP. The total liquid waste collected from the tarps was 20 gallons (73 kg). TCLP lead was 0.41 ppm. The wastewater was below the EPA limit for lead and was considered nonhazardous waste.

The power tool cleaning waste was weighed and tested for total and TCLP lead. The total weight of power tool cleaning debris collected was 0.22 kg. Total and TCLP lead were 83,000 ppm and 270 ppm, respectively. The power-tool cleaning debris was above the EPA limit for leachable lead (>5ppm lead) and was disposed of as hazardous waste.

The worker operating a vacuum-shrouded rotary power tool wore a PAM device for the 120-minute duration of the power-tool cleaning. The worker exposure was 81 $\mu\text{g}/\text{m}^3$. Averaged over an 8-hour workday, the exposure was 20 $\mu\text{g}/\text{m}^3$. The action level for lead exposure is 30 $\mu\text{g}/\text{m}^3$ for an 8-hour workday. If the work duration had been 8 hours, then the lead action level would have been exceeded.

The two overcoat systems on the deluge tank were inspected in March 2001. DFT, corrosion, appearance, and adhesion were evaluated. Table 1 presents the inspection results for both test areas.

Table 1. Water tank overcoat performance.

Test Area	Appearance	Rust (%)	DFT Range (mils)	Avg. DFT (mils)	Adhesion (D 3359)
1	rust stain	0	7.1 – 12.7	9.6	5A
2	rust stain	0	6.9 – 13.2	9.7	5A

HAAP Railroad Bridge

Approximately 3 to 4 sq ft, or less than 1 percent of the total test area was power-tool cleaned (SP 3). Approximately 25 sq ft of surface was primed with SSPC Paint 25 using a natural bristle brush. The approximate WFT of the primer was 3 to 5 mils. The air temperature at the time of application was 55 °F and the surface temperature was 56 °F. After a drying period of 21 hours, the first coat of TT-P-38E was applied by brush and roller. The approximate WFT was 2 to 2.5 mils. The air temperature at the time of application was 74 °F and the surface temperature was 55 to 62 °F. The second coat of TT-P-38E was applied after a drying period of 16 hours. The approximate WFT was 2 to 2.5 mils. The air temperature at the time of application was 59 °F.

The SSPC Paint 25 primer was just barely set-to-touch after 21 hours when the first topcoat was applied. Contrast in appearance between coats of TT-P-38 was sufficient to allow easy recoat. TT-P-38 contains leafing aluminum pigment. During application the pigment does not immediately leaf and the coating has a dull gray color. The dull gray contrasted nicely with the dried first coat of TT-P-38, which had gone through the leafing process to develop the characteristic shiny silver appearance of a leafing aluminum topcoat.

The second test area was primed with Wasser MC-Aluminum applied by brush and roller. The approximate WFT was 2.5 to 3.5 mils. The air temperature at the time of application was 54 °F and the surface temperature was 52 to 54 °F. The relative humidity was 98 percent. A second coat of MC-Aluminum was applied after a drying period of 4 to 5 hours. The approximate WFT was 2.5 to 3.5 mils. The air temperature at the time of application was 74 °F, and the surface temperature was 55 to 62 °F.

Waste minimization was accomplished by hand washing rather than power washing the existing coating. Wash and rinse water were evaporated from the tarps to further reduce the amount of waste. Debris was collected from the tarps, weighed, and tested for total lead and TCLP. The total waste collected from the tarps was 6.49 kg. Total and TCLP lead were 25,000 ppm and 6 ppm, respectively. The tarp debris exhibited the hazardous characteristic for lead (>5 ppm leachable lead).

The power-tool cleaning waste was weighed and tested for total and TCLP lead. The total weight of power tool cleaning debris collected was 0.38 kg. Total and TCLP lead were 70,000 ppm and 220 ppm, respectively. The power-tool cleaning debris was above the EPA limit for leachable lead (>5 ppm lead) and was disposed of as hazardous waste.

The worker operating the vacuum shrouded needle gun wore a PAM device for the 85-minute duration of power-tool cleaning. No airborne lead was detected. Based on the sample results, there was no lead exposure. Based on the calculated reporting limit, however, the lead exposure was 12 $\mu\text{g}/\text{m}^3$. Averaged over an 8-hour workday, the exposure based on the calculated reporting limit would be 2.1 $\mu\text{g}/\text{m}^3$. The Occupational Safety and Health Administration (OSHA) requires that air monitoring data and exposure levels be reported based on the operating detection limit if no lead is detected. The action level for lead exposure is 30 $\mu\text{g}/\text{m}^3$ for an 8-hour work day. A half-mask respirator with an APF of 10 was worn by the power tool operator. The vacuum shroud alone provided an adequate degree of worker protection.

An evaluation of the overcoat systems was performed after 6 months of service. The period of service included the winter months with several periods of freeze-thaw. The overcoated surfaces were inspected for coating DFT, corrosion, and adhesion. The results are presented in Table 2.

Table 2. Railroad bridge overcoat performance.

Paint System	Area	Average Paint Thickness (mils)	Adhesion (D 3359)	Rust (%)
Test Area 1	South stringer, north side	15.2	5A	0
	South stringer, south side	12.5	4A	0
	North stringer, north side	16.0	5A	0
	South truss, north side	10.2	5A	0
	South truss, south side	14.0	4A	0
	North truss, north side	15.2	5A	0
	North truss, south side	13.2	5A	0
Test Area 2	South stringer, north side	16.3	5A	0
	South stringer, south side	13.8	4A	0
	North stringer, north side	14.9	5A	0
	South truss, north side	11.2	5A	0
	South truss, south side	15.2	5A	0
	North truss, north side	13.9	5A	0
	North truss, south side	17.6	3A	0

Data Assessment

Fort Campbell Water Tank

Areas of the dried primer, Mio Aluminum, were observed to have numerous tiny bubbles over the prepared rust spots. These areas appear slightly rough. The bubbles are characteristically formed in polyurethane films as carbon dioxide is evolved. The problem occurs when the cure reaction occurs too rapidly or the coating is applied too thickly. Wasser recommends that Mio Aluminum be applied at a WFT of 2.5 to 3.0 mils. The achieved WFT was slightly above the recommended range. High humidity also promotes rapid cure. Painting conditions were nearly ideal and humidity was not high during application. The bubbling may have been caused by a combination of relatively high WFT and moisture retained in the rust.

Both overcoat systems were performing well after 5 months of service. The winter months were relatively harsh with numerous freeze-thaw cycles. Intercoat adhesion between the overcoat systems and the original paint system was excellent. The adhesion of the original coating to the substrate was unaffected by either overcoat system. The risk that a catastrophic delamination failure will occur in the future is negligible. Both systems were devoid of any sign of early corrosion. Some rust staining of the overcoated areas had occurred as a result of wash down from corroded surfaces above the repaired areas.

After evaluation of the two coating systems, the coating system composed of Sherwin-Williams Corothane I Mastic primer, Corothane I Ironox A intermediate, and Corothane I Ironox A topcoat was chosen for completion of the tank coating job, as shown in Figure 4. The projected life of the overcoat repair on this tank is 15 to 25 years. This projection is based on the pre-overcoat condition of the original paint system, the durability of the overcoat materials, and the severity of the exposure environment. It should also be noted that the water tank can probably be overcoated two more times provided its condition is not allowed to deteriorate past that which is suitable for overcoating.

HAAP Railroad Bridge

Areas of dried MC-Aluminum coating were observed to have numerous tiny bubbles. These areas appeared slightly rough. The formation of these bubbles is a characteristic flaw of polyurethane coatings and occurs when carbon dioxide forms and escapes from the partially cured film. The problem is exacerbated when the cure reaction occurs too rapidly or the coating is applied at too great a thickness. The coating manufacturer recommends that MC-Aluminum not be applied at a WFT of greater than 8 mils. The recommended maximum thickness was not exceeded. High humidity also promotes rapid cure. Humidity was high during paint application but was within the manufacturer's recommended range. The bubbling was probably caused by a combination of relatively high WFT and high humidity. Manufacturer data sheets do not necessarily address intermediate conditions or multiple effects.



Figure 4. Deluge tank at Fort Campbell Army Airfield after overcoating completed in August 2001.

Both overcoat systems were performing well after 6 months of service. The winter months were relatively harsh with numerous freeze-thaw cycles. Intercoat adhesion between the overcoat systems and the original paint system was excellent. The adhesion of the original coating to the substrate was unaffected by either overcoat system. Coating adhesion to the substrate was slightly less for surfaces with a south solar orientation. This is typical of alkyd-type paint systems as they tend to embrittle and lose adhesion with prolonged exposure to ultraviolet radiation. The risk that a catastrophic delamination failure will occur in the future is very small. Both systems are devoid of any sign of early corrosion.

The projected life of an overcoat repair is 12 to 18 years. This projection is based on the pre-overcoat condition of the original paint system, the durability of the overcoat materials, and the severity of the exposure environment.

Technology Comparison

Complete coating removal by abrasive blasting with coal slag abrasive would have produced approximately 15,000 lb (6800 kg) of hazardous waste per 1,000 sq ft. The quantity of hazardous waste generated was less than 0.1 percent of what would be produced using expendable coal slag abrasive.

Complete coating removal by abrasive blasting inside of a properly designed and ventilated containment structure would have exposed workers to a lead concentration up to 58,700 $\mu\text{g}/\text{m}^3$ with a presumed exposure of over 2,500 $\mu\text{g}/\text{m}^3$. Coating removal using nonvacuum-assisted power tools would have exposed workers to a lead concentration of up to 20,000 $\mu\text{g}/\text{m}^3$ with a presumed exposure of up to 2,500 $\mu\text{g}/\text{m}^3$. The use of vacuum-assisted power-tool cleaning greatly reduced potential lead exposures during surface preparation.

Complete coating removal by abrasive blasting with containment has high risk of environmental exposure. Power-tool cleaning has a low to moderate risk and vacuum-assisted power-tool cleaning has only a low risk of environmental exposure.

Overcoated LBP will not last as long as a new high performance coating system applied to a well-prepared blast cleaned surface. The projected overcoat life for the water tank is 15 to 25 years. The original coating system lasted 40 years with no maintenance.

5 Cost Assessment

Cost Reporting and Analysis

Cost was measured using the Bureau of Labor Statistics 1998 National Occupational Employment Wage Estimates for labor category 87402 Painters and Paperhangers, Construction and Maintenance. The 90th percentile wage (\$21.40/h) adjusted for inflation (2 percent per annum) was used. A 50-percent burden was added to cover insurance, pension, annuity, vacation, and profit. The labor cost used for the cost estimate was \$33.40/h. Labor and cost details are tabulated below.

Fort Campbell Water Tank

The estimated unit area cost for overcoating the tank was \$1.55/sq ft (see Table 3). Work was performed on portions of the tank that were generally more accessible. The estimated unit area cost range for overcoating similar tanks and other simple structures is \$1.40/sq ft to \$1.86/sq ft.

Table 3. Water tank cost report.

Work Phase	Hours
Mobilization	6.0
Washing	8.75
Power Tool Cleaning	4.0
Solvent Wipe	1.0
Painting System 1	4.5
Painting System 2	4.5
Demobilization	4.0
Cost	(\$/sq ft)
Mobilization/Demobilization	0.167
Surface Preparation	0.383
Paint Application	0.251
Paint and Expendables (est.)	0.750
Waste Disposal	0.000
Total Cost	1.551

HAAP Railroad Bridge

The estimated unit area cost for overcoating the bridge is \$2.83/sq ft (see Table 4). Work was performed on portions of the bridge that were generally more accessible. The estimated unit area cost for overcoating the bridge and other complex structures is \$2.55/sq ft to \$3.39/sq ft.

Table 4. Railroad bridge cost report.

Work Phase	Hours
Mobilization	18.0
Washing	12.5
Power Tool Cleaning	1.5
Solvent Wipe	5.5
Painting System 1	15.0
Painting System 2	14.5
Demobilization	6.0
Cost	(\$/sq ft)
Mobilization/Demobilization	0.802
Surface Preparation	0.651
Paint Application	0.985
Paint and Expendables (est.)	0.395
Waste Disposal	0.003
Total Cost	2.836

Cost Comparison

Cost-effective removal of hazardous LBP is generally performed by abrasive blasting or by water jetting. Containment and disposal of surface preparation debris, worker protection, and other regulatory compliance costs combine to make removal of LBP very expensive. The FHWA example showed that typical bridge maintenance painting contracts involving complete coating removal and repainting averaged \$5.05/sq ft for nonhazardous coatings and \$10.60/sq ft for hazardous paint removal. The added costs for worker health, environmental monitoring, waste disposal, and containment are significant (FHWA 1995).

The installed cost of overcoating on a simple structure (Fort Campbell water tank) was estimated at \$1.55/sq ft. The installed cost for overcoating on a complex structure (HAAP railroad bridge) was estimated at \$2.83/sq ft. By comparison, the cost of deleading and installing a new paint system is \$5 to \$18/sq ft with an average cost of \$8/sq ft.

Case-specific economic analysis is recommended for measuring the life-cycle cost of repainting versus overcoating. The maintenance painting option, overcoating or repainting, with the lowest total net present value should be implemented.

Overcoating in a mild exposure environment is always cheaper than repainting, but it is not economically viable in a severe exposure environment. Overcoating may or may not be more economical in a moderate exposure environment.

6 Implementation Issues

Cost Observations

Overcoating simple structures is significantly less expensive than overcoating more complex structures. The less complex a structure is, the less expensive overcoating will be and life cycle costs will be more favorable.

Other Significant Observations

In many cases, overcoating has been used inappropriately by the industry. Because of the potentially large initial cost savings associated with overcoating, as opposed to containment and removal, the temptation to overcoat is great. The large initial cost difference between these maintenance options has meant that owners are more tolerant of the risks involved in overcoating. Owners should first properly assess the risks, and if overcoating risks are deemed acceptable, then the facility owner should take additional steps to mitigate the risk of overcoating.

The primary risk associated with overcoating is that the coating system will delaminate. If a delamination failure occurs, then the overcoating investment is lost. Delamination of a lead-containing coating may also represent an environmental hazard. In this case, the possibility for litigation is very real. The remedial cost of an unintentional introduction of lead into the environment may be significant. Delamination is difficult to predict. An understanding of the underlying principles, however, should help the coatings engineer prevent or reduce the chance of suffering a delamination failure.

Delamination is primarily the result of internal stresses in the overcoat material that cannot be supported by the underlying aged coating. Internal stress occurs as the applied overcoat contracts, either from solvent evaporation or curing. Several factors affect the degree of internal stress in the overcoat material, including type of coating, formulation, and film forming conditions. As coatings age, film stress generally increases. Aging may result in additional cross-linking and film shrinkage. A good example of age-related stress increase is the oxidative curing of alkyds. Temperature fluctuations may also affect the level of internal stress, with higher

temperatures favoring lower stress and colder temperatures causing higher stress. The higher stress associated with cold temperatures is the major cause of overcoat system failure by delamination. Plasticizer migration may lead to reduced elasticity or embrittlement of both aged coatings and overcoats. Brittle coatings are more apt to crack during temperature cycles. The application of the overcoat may also affect the internal stress of the aged coating. Solvent migration may initially reduce the stress in the existing coating, but subsequent solvent evaporation will result in an increase in the film stress. Resin in the overcoat material may penetrate the aged paint to form a stress zone within the old coating. The stress present in the overcoat is important because it is transmitted to the base coating.

The internal stress of the overcoat is counteracted by its adhesion to the aged coating. A loss of adhesion of the aged coating may result in cracking of the overcoat because the underlying coating no longer supports internal stress. This is true when the internal stress of the overcoat exceeds its tear strength. When the tensile stress in the overcoat exceeds that in the aged coating and the overcoat cracks, then peeling and delamination are likely to occur. Good overcoat/basecoat systems, like all multi-coat systems, should have higher tensile strength and rigidity in the basecoat than in the topcoat. New coating systems are specifically designed this way. Overcoat/basecoat systems should be designed this way as well. In practice, however, it is difficult to assure that the stress of the overcoat will not overwhelm the adhesion of the old existing coating.

The other primary risk associated with overcoating is that the overcoat system will not provide a long enough period of service to be considered cost effective. In this case, the overcoat system may not experience a catastrophic failure such as delamination, but may fail prematurely because of the severity of the service environment and/or the degree of protection afforded by the overcoat material. Such failures are typified by early onset or excessive rust-through.

Thicker aged coatings tend to be more highly stressed. Large peeling forces can be generated during curing and aging of the overcoat. When overcoated, thicker more highly stressed coatings are more likely to delaminate than thinner coatings with lower internal stress. Delamination may also be caused by thermal cycling, which may disrupt the integrity of thick aged coatings that have been overcoated. Thicker, more highly stressed coatings are also more likely to sustain blast media or other mechanically induced damage with a subsequent loss of adhesion that may affect the performance of the overcoat system.

The mechanical properties of coatings may change as they age. Age-related changes are due primarily to changes within the coating that increase the glass transition

temperature. As a coating's glass transition temperature increases, its internal stress increases, adhesion decreases, and brittleness increases. The glass transition temperature increase is generally the result of thermal and photo radiation effects. For acrylic latex coatings, it has been shown that the temperature increase is due entirely to photo radiation. For oil paint the effect is mainly due to photo radiation; for alkyd, it is due to both thermal and photo radiation, with thermal effects playing a greater role. Long oil coatings generally take longer to embrittle than short oil coatings.

Epoxy and alkyd coatings may chalk and erode with prolonged exposure. Generally, this does not present a problem for overcoating as long as the loose chalk is removed before overcoating. Even severely eroded coatings with exposed primer may be good candidates for overcoating, provided the remaining coating has good adhesion and total rusting is nominal.

The degree of adhesion of the aged coating to the substrates is one of the most critical factors affecting the overcoating process. Poorly adherent coatings are more likely to delaminate when overcoated than are aged coatings with good adhesion. Poor intercoat adhesion in aged multi-coat systems may also result in overcoat delamination failures. Generally the aged coating system will fail at its weakest point. Coating type, age, thickness, and surface preparation may all affect the adhesion of the aged coating system.

The condition of the substrate may also affect the performance of the overcoat system. In general, if more corrosion is present, more surface preparation will be needed. Mechanical cleaning, especially abrasive blasting, may disrupt the adhesion of the aged coating adjacent to the removal areas. Additionally, overcoating may not be cost effective if extensive surface preparation is required. The original surface preparation may also play a role in the performance of the overcoat to the extent that it affects coating adhesion on mill scale and other poorly cleaned surfaces. This effect may cause localized problems on structures that were not cleaned uniformly before receiving the original coating.

The problems associated with surface contaminants are not necessarily specific to overcoating; however, contaminants are less likely to be removed during overcoating because much less surface preparation is typically done. Less surface preparation is performed to lower costs and to reduce environmental and worker exposures to hazardous dusts. Rigorous surface preparation is also more likely to cause mechanical damage to an old marginally adherent embrittled coating that may later manifest itself as a delamination failure.

As noted above, thermal- and photo radiation-induced increases to the glass transition temperature may lead to embrittlement and reduced adhesion of the aged coating. Oil and oil-modified alkyds on structural components exposed to thermal and photo radiation, will be more prone to these age-related effects. Similar coatings in protected areas not directly exposed to the sun may be more suitable for overcoating. Thermal cycling is another weather-related effect. Internal coating stresses may increase to unsupportable levels at low temperatures, explaining why many overcoat delamination failures occur during or after cold spells. Structures in mild climates are less likely to be exposed to low temperatures that may precipitate delamination failures. Conversely, oil and alkyd coatings exposed in sunny climates may age faster than in other locales.

Severe exposure environments, including fresh and saltwater immersion and chemical and marine atmospheres, are usually not suitable for overcoating. FHWA and Army research has shown that, for severe service environments, total removal and replacement of the aged coating with a high performance coating system is more cost effective than overcoating.

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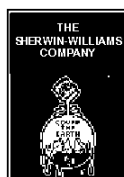
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Corrosion Control Consultants & Labs.	Phone: 630-834-3811	Principal Contractor
Corrosion Control Consultants & Labs.	Phone: 616-940-3112	Principal Contractor
* Toxic Substances Control Act		

List of Acronyms

APF	Assigned Protection Factor
ASTM	American Society for Testing and Materials
DFT	dry film thickness
DoD	Department of Defense
EPA	Environmental Protection Agency
ESTCP	Environmental Security Technology Certification Program
FHWA	Federal Highway Administration
HAAP	Holston Army Ammunition Plant
HEPA	High Efficiency Particulate Air
LBP	lead-based paint
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PAM	personal air monitoring
POL	petroleum, oils, and lubricants
PPM	part per million
SSPC	The Society for Protective Coatings
TCLP	Toxic Characteristic Leaching Procedure
WFT	wet film thickness

Appendix: Overcoat System Material Safety Data Sheets



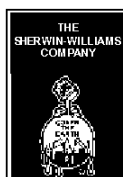
*Industrial
and
Marine
Coatings*

5.03
**COROTHANE® I
MASTIC**
B65R13

INDUSTRIAL & MARINE COATINGS		PRODUCT INFORMATION		Revised 7/02																									
PRODUCT DESCRIPTION			RECOMMENDED USES																										
<p>COROTHANE I - MASTIC is a single component, moisture curing urethane with micaceous iron oxide, designed as a primer or intermediate coat for previously painted steel surfaces, including lead overcoating. It is high solids and VOC compliant. Product is designed to be topcoated.</p> <ul style="list-style-type: none">• Out performs epoxy mastics when overcoating old red lead coatings• Low temperature application - down to 20°F• Can be applied in humidities up to 99%• Excellent recoatability• Superior to epoxy mastics for flexibility, corrosion resistance, blister resistance, and impact resistance			<ul style="list-style-type: none">• As a universal primer or intermediate coat for previously painted surfaces, steel, and weathered galvanized steel• For application during cold, damp, and/or high humidity conditions limiting the use of conventional coatings																										
PRODUCT CHARACTERISTICS			PERFORMANCE CHARACTERISTICS																										
<p>Finish: Matte</p> <p>Color: Reddish Gray</p> <p>Volume Solids: 60% ± 2%</p> <p>VOC (calculated): <340 g/L; 2.8 lb/gal</p> <p>Recommended Spreading Rate per coat:</p> <p>Wet mils: 4.0 - 5.5</p> <p>Dry mils: 2.5 - 3.5</p> <p>Coverage: 275 - 385 sq ft/gal approximate.</p> <p>Drying Schedule @ 5.0 mils wet @ 50% RH:</p> <table><tr><th></th><th>@55°F</th><th>@ 77°F</th><th>@100°F</th></tr><tr><td>To touch:</td><td>40 minutes</td><td>30 minutes</td><td>15 minutes</td></tr><tr><td>To recoat minimum:</td><td>7 hours</td><td>4 hours</td><td>4 hours</td></tr><tr><td>maximum:</td><td>60 days</td><td>60 days</td><td>60 days</td></tr><tr><td>To handle:</td><td>24 hours</td><td>18 hours</td><td>5 hours</td></tr><tr><td>To cure:</td><td>7 days</td><td>3 days</td><td>3 days</td></tr></table> <p>Drying time is temperature, humidity, and film thickness dependent.</p> <p>Shelf Life: 12 months, unopened, at 77°F</p> <p>Flash Point: >93°F, PMCC</p> <p>Reducer/Clean Up: Reducer #15, R7K15</p>				@55°F	@ 77°F	@100°F	To touch:	40 minutes	30 minutes	15 minutes	To recoat minimum:	7 hours	4 hours	4 hours	maximum:	60 days	60 days	60 days	To handle:	24 hours	18 hours	5 hours	To cure:	7 days	3 days	3 days	<p>System Tested: (unless otherwise indicated)</p> <p>Substrate: Steel</p> <p>Surface Preparation: SSPC-SP6</p> <p>1 ct. Corothane I - MIO-Aluminum @ 3.0 mils dft</p> <p>1 ct. Corothane I - Mastic @ 3.0 mils dft</p> <p>Abrasion Resistance:</p> <p>Method: ASTM D4060, CS17 wheel, 1000 cycles, 1 kg load</p> <p>Result: 17 mg loss</p> <p>Adhesion:</p> <p>Method: ASTM D4541</p> <p>Result: 1000 psi</p> <p>Corrosion Weathering:(Zinc Primer/Mastic/Aliphatic Finish)</p> <p>Method: ASTM D5894, 3024 hours, 9 cycles</p> <p>Result: Rating 10 per ASTM D714 for blistering</p> <p>Rating 9 per ASTM D610 for rusting</p> <p>Direct Impact Resistance:</p> <p>Method: ASTM D2794</p> <p>Result: 60 in. lbs.</p> <p>Dry Heat Resistance:</p> <p>Method: ASTM D2485</p> <p>Result: 300°F</p> <p>Flexibility:</p> <p>Method: ASTM D522, 180° bend, 3/8" mandrel</p> <p>Result: Passes</p> <p>Moisture Condensation Resistance:</p> <p>Method: ASTM D4585, 100°F, 300 hours</p> <p>Result: Passes</p> <p>Pencil Hardness:</p> <p>Method: ASTM D3363</p> <p>Result: 2B</p> <p>Salt Fog Resistance: (Zinc Primer/Mastic/Aliphatic Finish)</p> <p>Method: ASTM B117, 3000 hours</p> <p>Result: Rating 10 per ASTM D714 for blistering</p> <p>Rating 9 per ASTM D610 for rusting</p> <p>Wet Heat Resistance:</p> <p>Method: Non-immersion</p> <p>Result: 180°F</p>		
	@55°F	@ 77°F	@100°F																										
To touch:	40 minutes	30 minutes	15 minutes																										
To recoat minimum:	7 hours	4 hours	4 hours																										
maximum:	60 days	60 days	60 days																										
To handle:	24 hours	18 hours	5 hours																										
To cure:	7 days	3 days	3 days																										

Polyurethane 5.03 2004744

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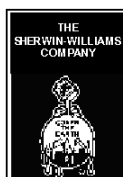
PRODUCT INFORMATION	
RECOMMENDED SYSTEMS	SURFACE PREPARATION
Steel: 1 ct. Corothane I - GalvaPac Zinc Primer @ 3.0 - 4.0 mils dft 1 ct. Corothane I - Mastic @ 2.5 - 3.5 mils dft 1 ct. Corothane I - Aliphatic @ 2.0 - 3.0 mils dft or Corothane I HS @ 2.0 - 3.0 mils dft Steel: 1 ct. Corothane I - PrePrime @ 1.5 - 2.0 mils dft 1 ct. Corothane I - MIO-Aluminum @ 2.0 - 3.0 mils dft 1 ct. Corothane I - Mastic @ 2.5 - 3.5 mils dft 1-2 cts. Corothane I - Aliphatic @ 2.0 - 3.0 mils dft/ct Steel: 1 ct. Corothane I - Mastic @ 2.5 - 3.5 mils dft 1-2 cts. Corothane I - Aliphatic @ 2.0 - 3.0 mils dft/ct Previously Painted Surfaces: Spot prime bare steel with 1 coat of Corothane I - GalvaPac Zinc Primer 1 ct. Corothane I - Mastic @ 2.5 - 3.5 mils dft 1 ct. Corothane I - Aliphatic @ 2.0 - 3.0 mils dft	Surface must be clean, dry, and in sound condition. Remove all oil, dust, grease, dirt, loose rust, and other foreign material to ensure adequate adhesion. Refer to product Application Bulletin for detailed surface preparation information. Minimum recommended surface preparation: Iron & Steel: SSPC-SP2, SP3 Previously Painted: SSPC-SP2, SP3
	TINTING
	Do not tint.
	APPLICATION CONDITIONS
	Temperature: air and surface: 20°F minimum, 100°F maximum material: 45°F minimum Do not apply over surface ice Relative humidity: Can be applied at relative humidities up to 99%. Refer to product Application Bulletin for detailed application information.
	ORDERING INFORMATION
	Packaging: 1 and 5 gallon containers Weight per gallon: 18.0 ± 0.2 lb
	SAFETY PRECAUTIONS
	Refer to the MSDS sheet before use. Published technical data and instructions are subject to change without notice. Contact your Sherwin-Williams representative for additional technical data and instructions.
The systems listed above are representative of the product's use. Other systems may be appropriate.	



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INDUSTRIAL & MARINE COATINGS	APPLICATION BULLETIN		Revised 7/02
SURFACE PREPARATION		APPLICATION CONDITIONS	
<p>Surface must be clean, dry, and in sound condition. Remove all oil, dust, grease, dirt, loose rust, and other foreign material to ensure adequate adhesion.</p> <p>Iron & Steel Minimum surface preparation is Hand Tool Clean per SSPC-SP2. Remove all oil and grease from surface by Solvent Cleaning per SSPC-SP1. For better performance, use Commercial Blast Cleaning per SSPC-SP6, blast clean all surfaces using a sharp, angular abrasive for optimum surface profile (2 mils). Prime any bare steel within 8 hours or before flash rusting occurs.</p> <p>Previously Painted Surfaces If in sound condition, clean the surface of all foreign material. Smooth, hard, or glossy coatings and surfaces should be dulled by abrading the surface. Apply a test area, allowing paint to dry one week before testing adhesion. If adhesion is poor, or if this product attacks the previous finish, removal of the previous coating may be necessary. If paint is peeling or badly weathered, clean surface to sound substrate and treat as a new surface as above.</p>		<p>Temperature: air and surface: 20°F minimum, 100°F maximum material: 45°F minimum Do not apply over surface ice Relative humidity: Can be applied at relative humidities up to 99%.</p>	
		APPLICATION EQUIPMENT	
		<p>The following is a guide. Changes in pressures and tip sizes may be needed for proper spray characteristics. Always purge spray equipment before use with listed reducer. Any reduction must be compatible with the existing environmental and application conditions.</p> <p>Reducer/Clean Up Reducer #15, R7K15</p> <p>Airless Spray Pump 30:1 Pressure 1800 - 2000 psi Hose 1/4" ID Tip015" - .019" Filter 60 mesh Reduction as needed up to 10% by volume</p> <p>Conventional Spray Unit Graco Binks Gun 900 95 Fluid Nozzle 070 66/65 Air Nozzle 947 66PR Atomization Pressure 60-70 psi 60-70 psi Fluid Pressure 15-20 psi 15-20 psi Reduction as needed up to 10% by volume</p> <p>Brush Brush Natural Bristle Reduction as needed up to 10% by volume</p> <p>Roller Cover 3/8" natural or synthetic with phenolic core Reduction as needed up to 10% by volume</p> <p>If specific application equipment is listed above, equivalent equipment may be substituted.</p>	



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APPLICATION BULLETIN

APPLICATION PROCEDURES	PERFORMANCE TIPS																																		
<p>Surface preparation must be completed as indicated.</p> <p>Stir paint thoroughly prior to use with a power agitator. Filter slowly through a 55 mesh screen.</p> <p>Apply paint at the recommended film thickness and spreading rate as indicated below:</p> <p>Recommended Spreading Rate per coat:</p> <table><tr><td>Wet mils:</td><td>4.0 - 5.5</td></tr><tr><td>Dry mils:</td><td>2.5 - 3.5</td></tr><tr><td>Coverage:</td><td>275 - 385 sq ft/gal approximate.</td></tr></table> <p>Drying Schedule @ 5.0 mils wet @ 50% RH:</p> <table><tr><td></td><td>@ 55°F</td><td>@ 77°F</td><td>@ 100°F</td></tr><tr><td>To touch:</td><td>40 minutes</td><td>30 minutes</td><td>15 minutes</td></tr><tr><td>To recoat</td><td></td><td></td><td></td></tr><tr><td>minimum:</td><td>7 hours</td><td>4 hours</td><td>4 hours</td></tr><tr><td>maximum:</td><td>60 days</td><td>60 days</td><td>60 days</td></tr><tr><td>To handle:</td><td>24 hours</td><td>18 hours</td><td>5 hours</td></tr><tr><td>To cure:</td><td>7 days</td><td>3 days</td><td>3 days</td></tr></table> <p>Drying time is temperature, humidity, and film thickness dependent.</p> <p>Application of coating above maximum or below minimum recommended spreading rate may adversely affect coating performance.</p>	Wet mils:	4.0 - 5.5	Dry mils:	2.5 - 3.5	Coverage:	275 - 385 sq ft/gal approximate.		@ 55°F	@ 77°F	@ 100°F	To touch:	40 minutes	30 minutes	15 minutes	To recoat				minimum:	7 hours	4 hours	4 hours	maximum:	60 days	60 days	60 days	To handle:	24 hours	18 hours	5 hours	To cure:	7 days	3 days	3 days	<p>Stripe coat all crevices, welds, and sharp angles to prevent early failure in these areas.</p> <p>When using spray application, use a 50% overlap with each pass of the gun to avoid holidays, bare areas, and pinholes. If necessary, cross spray at a right angle.</p> <p>Spreading rates are calculated on volume solids and do not include an application loss factor due to surface profile, roughness or porosity of the surface, skill and technique of the applicator, method of application, various surface irregularities, material lost during mixing, spillage, overthinning, climatic conditions, and excessive film build.</p> <p>Excessive reduction of material can affect film build, appearance, and adhesion.</p> <p>In order to avoid blockage of spray equipment, clean equipment before use or before periods of extended downtime with Reducer #15, R7K15.</p> <p>Pour a small amount of Reducer #15, R7K15 over the top of the paint in the can to prevent skinning or gelling.</p> <p>Place a temporary cover over the pail to keep excessive moisture, condensation, fog, or rain from contaminating the coating.</p> <p>Corothane KA Accelerator is acceptable for use. See data page 5.98 for details.</p> <p>It is recommended that partially used cans not be sealed/closed for use at a later date.</p> <p>Product is designed to be topcoated.</p> <p>Refer to Product Information sheet for additional performance characteristics and properties.</p>
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*Industrial
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Marine
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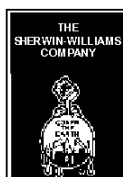
5.08
**COROTHANE® I
IRONOX A**
GRAY B65A10

INDUSTRIAL & MARINE COATINGS		PRODUCT INFORMATION		Revised 1/2002																							
PRODUCT DESCRIPTION			RECOMMENDED USES																								
<p>COROTHANE I IRONOX A is a single component, VOC compliant, moisture curing urethane finish coat with micaceous iron oxide, designed for low temperature or high humidity applications, providing UV resistance and chemical resistance equivalent to two part urethane coatings.</p> <ul style="list-style-type: none">• Low temperature application - down to 20°F• Provides resistance to yellowing, chalking, or degradation by sunlight• Excellent adhesion to most surfaces• Superior abrasion resistance• Outstanding chemical resistance• Suitable for use in USDA inspected facilities			<ul style="list-style-type: none">• Color topcoat for previously painted surfaces where maximum color retention and chemical resistance are required• Chemical resistant coating for metallized surfaces, containment ponds, and tanks• Superior coverage on edges and bridging over hairline cracks due to micaceous iron oxide• Recommended topcoat for lead overcoat system																								
PRODUCT CHARACTERISTICS			PERFORMANCE CHARACTERISTICS																								
<p>Finish: Low Gloss</p> <p>Color: Gray</p> <p>Volume Solids: 55% ± 2%</p> <p>Weight Solids: 74.7 % ± 2%</p> <p>VOC (calculated): <420 g/L; 3.5 lb/gal</p> <p>Recommended Spreading Rate per coat:</p> <table><tr><td>Wet mils:</td><td>4.0 - 7.0</td></tr><tr><td>Dry mils:</td><td>2.5 - 3.5</td></tr><tr><td>Coverage:</td><td>220 - 290 sq ft/gal approximate</td></tr></table> <p>Drying Schedule @ 5.0 mils wet @ 50% RH:</p> <table><tr><th></th><th>@55°F</th><th>@ 77°F</th><th>@100°F</th></tr><tr><td>To touch:</td><td>1-1/2 hours</td><td>1 hour</td><td>20 minutes</td></tr><tr><td>To recoat:</td><td>24 hours</td><td>4 hours</td><td>1 hour</td></tr><tr><td>To cure:</td><td>4 days</td><td>3 days</td><td>3 days</td></tr></table> <p>Drying time is temperature, humidity, and film thickness dependent.</p> <p>Shelf Life: 12 months, unopened, at 77°F</p> <p>Flash Point: >93°F, PMCC</p> <p>Reducer/Clean Up: Reducer #15, R7K15</p>			Wet mils:	4.0 - 7.0	Dry mils:	2.5 - 3.5	Coverage:	220 - 290 sq ft/gal approximate		@55°F	@ 77°F	@100°F	To touch:	1-1/2 hours	1 hour	20 minutes	To recoat:	24 hours	4 hours	1 hour	To cure:	4 days	3 days	3 days	<p>System Tested: (unless otherwise indicated)</p> <p>Substrate: Steel</p> <p>Surface Preparation: SSPC-SP5</p> <p>1 ct. Corothane I - GalvaPac Zinc Primer @ 3.0 mils dft</p> <p>1 ct. Corothane I - Mastic @ 2.5-3.5 mils dft</p> <p>1 ct. Corothane I - IronOx A @ 3.0 mils dft</p> <p>Abrasion Resistance:</p> <p>Method: ASTM D4060, CS17 wheel, 1000 cycles, 1 kg load</p> <p>Result: 30 mg loss</p> <p>Adhesion:</p> <p>Method: ASTM D4541</p> <p>Result: 1943 psi</p> <p>Corrosion Weathering:</p> <p>Method: ASTM D2984, 15 cycles, 5000 hours</p> <p>Result: Rating 10 per ASTM D610 for Rusting (field)</p> <p>Result: Rating 10 per ASTM D714 for Blistering</p> <p>Direct Impact Resistance:</p> <p>Method: ASTM D2794</p> <p>Result: 160 in. lbs.</p> <p>Dry Heat Resistance:</p> <p>Method: ASTM D2485</p> <p>Result: 280°F</p> <p>Flexibility:</p> <p>Method: ASTM D522, 180° bend, 1/8" mandrel</p> <p>Result: Passes</p> <p>Moisture Condensation Resistance:</p> <p>Method: ASTM D4585, 100°F, 4000 hours</p> <p>Result: No rust, delamination or creepage at scribe</p> <p>Pencil Hardness:</p> <p>Method: ASTM D3363</p> <p>Result: 2H</p> <p>Salt Fog Resistance:</p> <p>Method: ASTM B117, 5000 hours</p> <p>Result: Rating 10 per ASTM D610 for Rusting (field)</p> <p>Result: Rating 10 per ASTM D714 for Blistering</p> <p>Wet Heat Resistance:</p> <p>Method: Non-immersion</p> <p>Result: 180°F</p>		
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Polyurethane

5.08 2004751

continued on back



*Industrial
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5.08 COROTHANE® I IRONOX A

GRAY

B65A10

PRODUCT INFORMATION	
RECOMMENDED SYSTEMS	SURFACE PREPARATION
Steel: 1 ct. Corothane I - GalvaPac Zinc Primer @ 3.0 - 4.0 mils dft 1-2 cts. Corothane I - IronOx A @ 2.5 - 3.5 mils dft/ct Steel: 1 ct. Corothane I - GalvaPac Zinc Primer @ 3.0 - 4.0 mils dft 1 ct. Corothane I - Mastic @ 2.5-3.5 mils dft 1 ct. Corothane I - IronOx A @ 2.5 - 3.5 mils dft Steel: 1 ct. Corothane I - PrePrime @ 1.5 - 2.0 mils dft 1 ct. Corothane I - MIO-Aluminum @ 2.0-3.0 mils dft 1 ct. Corothane I - Mastic @ 2.5-3.5 mils dft 1 ct. Corothane I - IronOx A @ 2.5 - 3.5 mils dft Concrete, smooth: 1 ct. Corothane I - PrePrime @ 1.5 - 2.0 mils dft 1 ct. Corothane I - IronOx A @ 2.5 - 3.5 mils dft Previously Painted Surfaces: Spot prime bare steel with 1 coat of Corothane I - GalvaPac Zinc Primer 2 cts. Corothane I - IronOx A @ 2.5 - 3.5 mils dft or 1 ct. Corothane I - Mastic @ 2.5 - 3.5 mils dft/ct 1 ct. Corothane I - IronOx A @ 2.5 - 3.5 mils dft (Check compatibility)	Surface must be clean, dry, and in sound condition. Remove all oil, dust, grease, dirt, loose rust, and other foreign material to ensure adequate adhesion. Refer to product Application Bulletin for detailed surface preparation information. Minimum recommended surface preparation: * Iron & Steel: SSPC-SP6 Concrete & Masonry: SSPC-SP13/NACE 6 Previously Painted: Clean, dry, sound * Primer required
COLOR AVAILABILITY/TINTING	
Color: Gray Do not tint.	
APPLICATION CONDITIONS	
Temperature: air and surface: 20°F minimum, 100°F maximum material: 45°F minimum Do not apply over surface ice Relative humidity: Can be applied at relative humidities up to 99%. Refer to product Application Bulletin for detailed application information.	
ORDERING INFORMATION	
Packaging: 1 and 5 gallon containers Weight per gallon: 13.4 ± 0.2 lb depending on color	
SAFETY PRECAUTIONS	
Refer to the MSDS sheet before use. Published technical data and instructions are subject to change without notice. Contact your Sherwin-Williams representative for additional technical data and instructions.	
The systems listed above are representative of the product's use. Other systems may be appropriate.	



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5.08A COROTHANE® I IRONOX A

GRAY

B65A10

INDUSTRIAL
& MARINE
COATINGS

APPLICATION BULLETIN

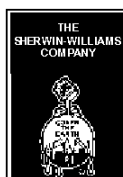
Revised 1/2002

SURFACE PREPARATION	APPLICATION CONDITIONS				
<p>Surface must be clean, dry, and in sound condition. Remove all oil, dust, grease, dirt, loose rust, and other foreign material to ensure adequate adhesion.</p> <p>Iron & Steel Remove all oil and grease from surface by Solvent Cleaning per SSPC-SP 1. Minimum surface preparation is Commercial Blast Cleaning per SSPC-SP6. For better performance, use Near White Metal Blast Cleaning per SSPC-SP10. Blast clean all surfaces using a sharp, angular abrasive for optimum surface profile (2 mils). Prime any bare steel the same day as it is cleaned.</p> <p>Poured Concrete New For surface preparation, refer to SSPC-SP13/NACE 6. Surface must be clean, dry, sound, and offer sufficient profile to achieve adequate adhesion. Minimum substrate cure is 28 days at 75°F. Remove all form release agents, curing compounds, salts, efflorescence, laitance, and other foreign matter by sandblasting, shotblasting, mechanical scarification, or suitable chemical means. Refer to ASTM D4260. Rinse thoroughly to achieve a final pH between 6.0 and 10.0. Allow to dry thoroughly prior to coating.</p> <p>Old Surface preparation is done in much the same manner as new concrete; however, if the concrete is contaminated with oils, grease, chemicals, etc., they must be removed by cleaning with a strong detergent. Refer to ASTM D4258. Form release agents, hardeners, etc. must be removed by sandblasting, shotblasting, mechanical scarification, or suitable chemical means. If surface deterioration presents an unacceptably rough surface, Kem Cat-Coat HSEpoxy Filler/Sealer is recommended to patch and resurface damaged concrete. Fill all cracks, voids and bugholes with ArmorSeal Crack Filler. Always follow the ASTM methods listed below: ASTM D4258 Standard Practice for Cleaning Concrete. ASTM D4259 Standard Practice for Abrading Concrete. ASTM D4260 Standard Practice for Etching Concrete. ASTM D4263 Plastic Sheet Method for Checking Moisture in Concrete. SSPC-SP 13/Nace 6 Surface Preparation of Concrete</p> <p>Previously Painted Surfaces If in sound condition, clean the surface of all foreign material. Smooth, hard or glossy coatings and surfaces should be dulled by abrading the surface. Apply a test area, allowing paint to dry one week before testing adhesion. If adhesion is poor, or if this product attacks the previous finish, removal of the previous coating may be necessary. If paint is peeling or badly weathered, clean surface to sound substrate and treat as a new surface as above.</p>	<p>Temperature: air and surface: 20°F minimum, 100°F maximum material: 45°F minimum Do not apply over surface ice</p> <p>Relative humidity: Can be applied at relative humidities up to 99%.</p> <tr><th colspan="2">APPLICATION EQUIPMENT</th></tr> <tr><td colspan="2"><p>The following is a guide. Changes in pressures and tip sizes may be needed for proper spray characteristics. Always purge spray equipment before use with listed reducer. Any reduction must be compatible with the existing environmental and application conditions.</p><p>Reducer/Clean Up Reducer #15, R7K15</p><p>Airless Spray Pump 30:1 Pressure 1800 - 2000 psi Hose 1/4" ID Tip011" - .015" Filter 60 mesh Reduction as needed up to 10% by volume</p><p>Conventional Spray Unit Graco Binks Gun 900 95 Fluid Nozzle 070 66/65 Air Nozzle 947 66PR Atomization Pressure 60-70 psi 60-70 psi Fluid Pressure 15-20 psi 15-20 psi Reduction as needed up to 10% by volume</p><p>Brush Brush Natural Bristle Reduction as needed up to 10% by volume</p><p>Roller Cover 1/4" natural or synthetic with phenolic core Reduction as needed up to 10% by volume</p><p>If specific application equipment is listed above, equivalent equipment may be substituted.</p></td></tr>	APPLICATION EQUIPMENT		<p>The following is a guide. Changes in pressures and tip sizes may be needed for proper spray characteristics. Always purge spray equipment before use with listed reducer. Any reduction must be compatible with the existing environmental and application conditions.</p> <p>Reducer/Clean Up Reducer #15, R7K15</p> <p>Airless Spray Pump 30:1 Pressure 1800 - 2000 psi Hose 1/4" ID Tip011" - .015" Filter 60 mesh Reduction as needed up to 10% by volume</p> <p>Conventional Spray Unit Graco Binks Gun 900 95 Fluid Nozzle 070 66/65 Air Nozzle 947 66PR Atomization Pressure 60-70 psi 60-70 psi Fluid Pressure 15-20 psi 15-20 psi Reduction as needed up to 10% by volume</p> <p>Brush Brush Natural Bristle Reduction as needed up to 10% by volume</p> <p>Roller Cover 1/4" natural or synthetic with phenolic core Reduction as needed up to 10% by volume</p> <p>If specific application equipment is listed above, equivalent equipment may be substituted.</p>	
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Polyurethane

5.08A 2004751A

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5.08A COROTHANE® I IRONOX A

GRAY

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COATINGS

APPLICATION BULLETIN

APPLICATION PROCEDURES	PERFORMANCE TIPS																						
<p>Surface preparation must be completed as indicated.</p> <p>Stir paint thoroughly prior to use with a power agitator. Filter slowly through a 55 mesh screen.</p> <p>Apply paint at the recommended film thickness and spreading rate as indicated below:</p> <p>Recommended Spreading Rate per coat:</p> <table><tr><td>Wet mils:</td><td>4.0 - 7.0</td></tr><tr><td>Dry mils:</td><td>2.5 - 3.5</td></tr><tr><td>Coverage:</td><td>220 - 290 sq ft/gal approximate</td></tr></table> <p>Drying Schedule @ 5.0 mils wet @ 50% RH:</p> <table><tr><td></td><td>@55°F</td><td>@ 77°F</td><td>@100°F</td></tr><tr><td>To touch:</td><td>1-1/2 hours</td><td>1 hour</td><td>20 minutes</td></tr><tr><td>To recoat:</td><td>24 hours</td><td>4 hours</td><td>1 hour</td></tr><tr><td>To cure:</td><td>4 days</td><td>3 days</td><td>3 days</td></tr></table> <p>Drying time is temperature, humidity, and film thickness dependent.</p> <p>Application of coating above maximum or below minimum recommended spreading rate may adversely affect coating performance.</p>	Wet mils:	4.0 - 7.0	Dry mils:	2.5 - 3.5	Coverage:	220 - 290 sq ft/gal approximate		@55°F	@ 77°F	@100°F	To touch:	1-1/2 hours	1 hour	20 minutes	To recoat:	24 hours	4 hours	1 hour	To cure:	4 days	3 days	3 days	<p>Stripe coat all crevices, welds, and sharp angles to prevent early failure in these areas.</p> <p>When using spray application, use a 50% overlap with each pass of the gun to avoid holidays, bare areas, and pinholes. If necessary, cross spray at a right angle.</p> <p>Spreading rates are calculated on volume solids and do not include an application loss factor due to surface profile, roughness or porosity of the surface, skill and technique of the applicator, method of application, various surface irregularities, material lost during mixing, spillage, overthinning, climatic conditions, and excessive film build.</p> <p>Excessive reduction of material can affect film build, appearance, and adhesion.</p> <p>In order to avoid blockage of spray equipment, clean equipment before use or before periods of extended downtime with Reducer #15, R7K15.</p> <p>Pour a small amount of Reducer #15, R7K15 over the top of the paint in the can to prevent skinning or gelling.</p> <p>Place a temporary cover over the pail to keep excessive moisture, condensation, fog, or rain from contaminating the coating.</p> <p>Corothane KA Accelerator is acceptable for use. See data page 5.98 for details.</p> <p>When applying White or light colors of Corothane I - Aliphatic over dark colors or porous surfaces, a minimum of 2 coats is required for adequate hide.</p> <p>It is recommend that partially used cans not be sealed/closed for use at a later date.</p> <p>Refer to Product Information sheet for additional performance characteristics and properties.</p>
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MATERIAL SAFETY DATA SHEET

DATE OF PREPARATION: 09/27/97
 DATE OF LAST REVISION: 09/17/01
 MANUFACTURER'S CODE: MC-ALUMINUM 2.8
SECTION I: GENERAL
 MANUFACTURER'S NAME AND ADDRESS: WASSER HIGH-TECH COATINGS, INC.
 1004 WEST JAMES STREET, SUITE 100, KENT, WA 98032
 INFORMATION PHONE NUMBER: 253-850-2967
 EMERGENCY PHONE NUMBER: CHEMTREC 800-424-9300
 CHEMICAL FAMILY: MOISTURE-CURE, POLYURETHANE PAINT
 TRADE NAME: WASSER MC-ALUMINUM
 HMIS RATINGS: H-2,F-3,R-1

SECTION II: HAZARDOUS INGREDIENTS

INGREDIENTS	%WT	CAS NUMBER	EXPOSURE LIMITS TLV
POLYURETHANE PREPOLYMER	45-55	Proprietary	0.02ppm ceiling OSHA PEL
HIGH FLASH NAPHTHA	05-15	64742-95-6	50ppm-Manufacturer
XYLENE	05-15	1330-20-7	100ppm-TW8, OSHA 150ppm OSHA STEL 100ppm - TW8, ACGIH 150 ppm ACGIH STEL
ETHYLBENZENE	01-03	100-41-4	100ppm - TW8, OSHA 125ppm OSHA STEL 100ppm - TW8, ACGIH 125ppm ACGIH STEL
ALUMINUM POWDER	15-25	7429-90-5	5mg/m ³ - TWA, Respirable OSHA 15mg/m ³ - Dust OSHA 10mg/m ³ - TWA Dust ACGIH

SECTION III: PHYSICAL DATA

BOILING POINT: 260°F; 127°C
 APPROX. WEIGHT PER GALLON: 9.5 LBS; 1.1 g/cm³
 EVAPORATION RATE: SLOWER THAN ETHER
 VAPOR DENSITY: HEAVIER THAN AIR
 % VOLATILE (VOLUME): 38 (APPRX)
 VOC: LESS THAN 2.8 LBS/GAL; 340g/L
 APPEARANCE AND ODOR: SILVER COLORED LIQUID WITH AROMATIC SOLVENT ODOR
 SOLUBILITY IN WATER: NONE

SECTION IV: FIRE AND EXPLOSION INFORMATION

FLASH POINT: 83°F; 28°C, CLOSED CUP
 EXTINGUISHING MEDIA: DRY CHEMICAL, FOAM, CARBON DIOXIDE, WATER SPRAY
SPECIAL FIREFIGHTING PROCEDURES: Wear self-contained breathing apparatus (SCBA), with a full-face piece, operated in the positive-pressure mode. Full protective clothing such as rubber gloves, boots, etc. should be worn by firefighters. No skin should be exposed. Clear fire area of unprotected personnel. Water from fog nozzles may be useful to cool closed containers to prevent pressure build-up.
UNUSUAL FIRE AND EXPLOSION HAZARDS: Vapor is heavier than air. Under conditions of stagnant air, vapors can build up and travel a considerable distance along the ground to an ignition source, which may result in a flashback to the source of the vapors, or an explosion. Do not use or store near open flame, heat, sparks, electrical equipment or hot surfaces. Use only in well-ventilated areas. Closed containers may explode when exposed to extreme heat or burst when contaminated with water (CO₂ evolved). During a fire, isocyanate vapors and other irritating, highly toxic gases may be generated by thermal decomposition or combustion.

SECTION V: FIRST AID AND HEALTH HAZARD INFORMATION:**EMERGENCY FIRST AID:**

INGESTION: Gastro-intestinal distress. In the unlikely event of ingestion, call a physician immediately with a list of the ingredients.

SKIN: Remove heavily contaminated clothing. Wash affected skin thoroughly with soap and water.

EYE: Flush with water for at least 15 minutes and consult a physician. If irritation continues, consult a physician.

INHALATION: This is an industrial paint. The primary hazard is organic solvent. Inhalation of reactive polyurethane is unlikely unless spraying, then the hazard is spray dust. An inhalation above TLV can occur when spraying or painting in a confined space without respiratory protection. Remove exposed person to fresh air. Treat for exposure to organic solvent. Give mouth to mouth then oxygen if breathing has stopped. Contact a physician. Asthmatic type symptoms may develop and persist for 12-24 hours if exposed to excessive spray dust or fumes without respiratory protection. Treatment is symptomatic.

HEALTH HAZARD INFORMATION: SYMPTOMS OF OVER EXPOSURE:

INHALED: Nasal and respiratory tract irritation. Breathing solvent vapors at concentrations in air that exceed 80ppm can cause narcosis and central nervous system effects including dizziness, loss of coordination, drowsiness, headaches, confusion, fatigue, nausea, loss of appetite and/or loss of consciousness. Sensitized individuals may experience chest tightness, wheezing, coughing and/or shortness of breath. These symptoms may not appear for hours and may persist for 4-24 hours.

CONTACT WITH SKIN: Overexposure may cause severe irritation. Skin irritation to isocyanates and organic solvents may cause allergic dermatitis in individuals with prior sensitization. Exposure to dried paint or dust is not hazardous.

CONTACT WITH EYES: May cause severe irritation.

SWALLOWED: Any ingestion is harmful resulting in burning sensation in the mouth and stomach accompanied by abdominal distress.

HEALTH EFFECTS OR RISKS FROM UNPROTECTED EXPOSURE:

ACUTE: Prolonged unprotected breathing of solvent vapor or spray may cause eye, nose, respiratory tract and/or skin irritation. Allergic skin or respiratory reaction may occur in some individuals. Narcotic in high concentrations. Headache, nausea, confusion, reversible eye damage, abdominal pain, fatigue and loss of consciousness may occur.

CHRONIC: Long term unprotected exposure may lead to muscular weakness, confusion, impaired coordination, liver damage, kidney damage, dermatitis, mucous membrane damage, pulmonary edema, anorexia and/or blood disorders. Large decreases in lung function may occur with chronic overexposure to isocyanates.

Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage.

SECTION V, cont.

As a result of previous unprotected overexposure, certain individuals may develop isocyanate sensitization (chemical asthma) which will cause them to react to a later exposure to isocyanates well below the TLV. Sensitized individuals may show symptoms similar to individuals who show sensitization to specific dusts, animal furs, and other irritants if re-exposed to this product. This lung sensitivity can reappear in a sensitized individual if re-exposed. Skin sensitization can also result from overexposure.

Laboratory studies with rats have shown that petroleum distillates cause kidney damage and kidney or liver tumors. Several studies evaluating petroleum workers have not shown significant increases of kidney damage nor kidney or liver tumors. Prolonged and repeated unprotected breathing of spray mists and/or dusts over a period of years may cause lung disease.

This product contains no cancer agent found on any list.

SECTION VI: REACTIVITY DATA

CONDITIONS TO AVOID: Avoid heat, sparks, open flames and other sources of ignition.

INCOMPATIBILITY (MATERIALS TO AVOID): Mixing with water, alcohol, amines, strong acids and bases, oxidizing agents and surface active materials may cause reaction or gelling.

HAZARDOUS DECOMPOSITION PRODUCTS: Toxic gases and vapors including carbon monoxide, carbon dioxide, oxides of nitrogen, traces of HCN, isocyanates and other unidentified organic compounds.

CONDITIONS TO AVOID: Combining or mixing with water or other materials that react with isocyanates may cause gelation or premature reaction in the container.

SECTION VII: SPILL, LEAK, AND DISPOSAL INFORMATION:

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: This material is paint. Minor spills or leaks in well-ventilated area cause no hazard. Major spills in confined areas should be treated with care. Avoid all sources of ignition if solvent vapors are excessive or the spill is confined to a closed van or confined space. Persons not wearing protective equipment should avoid the area until solvent vapors have subsided. Avoid allowing spilled material to leak into any flowing water source. Material spilled on the ground can be contained and collected with absorbent. There is no danger of material penetrating into ground water if it is contained. Solvent evaporation will occur in spilled material if left in open ventilation leaving a solid stable non-hazardous residue. Dried material can be disposed of in landfill. Semi-dry and liquid should be collected and placed in sealed salvage containers or allowed to dry by evaporation in a well-ventilated area.

WASTE DISPOSAL PROCEDURES: Spilled product that is not a thin film dried paint must be disposed of as a hazardous solid waste according to Resource Conservation and Recovery Act regulations. Preferred method of disposal is incineration.

SECTION VIII: EMPLOYEE PROTECTION INFORMATION:

Precautions must be taken so those persons handling this material do not breathe the vapors above the TLV, or have it contact the skin or eyes. In spray operations, protection must be afforded against exposure to both vapor and spray mist.

EYE PROTECTION: Liquid chemical goggles. Vapor resistant goggles should be worn when contact lenses are in use. In a splash hazard environment: goggles or a full face-shield should be used.

SKIN PROTECTION: Permeation resistant gloves (butyl rubber, nitrile rubber, polyvinyl alcohol). Cover as much of the exposed skin area as possible with appropriate clothing. If skin creams are used, keep the area covered by the cream to a minimum.

RESPIRATOR: This product contains polymeric reactive polyurethane prepolymers. Due to the high molecular weight and low vapor pressure it is extremely unlikely that measurable reactive polymer can get into the vapor phase during normal mixing, stirring, brushing, or rolling applications; however, during spraying in confined spaces the spray mist particles may reach a hazardous level, even if the vapor phase does not contain hazardous levels. **Since this product contains organic solvent it is required to wear an organic vapor cartridge filter during stirring, brushing, rolling or inspection of drying paint. During spraying or application in confined spaces it is required to wear a full fresh air supplied respirator. This product will generally not show reactive isocyanate at levels above the TLV in the vapor phase, even during spray operations; however, during spray operations spray particles will contain reactive prepolymer at a hazardous level. These particles may penetrate a canister respirator if improperly fit or if not equipped with a HEPA prefilter. Therefore always wear a full fresh air supplied respirator during spray operations when airborne spray dust is present in hazardous levels.**

GLOVES: Skin contact should be minimized by wearing solvent impermeable gloves made of neoprene or nitrile rubber.

OTHER PROTECTIVE CLOTHING AND EQUIPMENT: Appropriate protective clothing necessary to prevent repeated or prolonged skin contact should be worn. Solvent resistant boots should be worn where spill or splashing can occur. If barrier creams are used, keep the area, which is protected only by the cream, to a minimum.

HYGIENIC WORK PRACTICES: Wash hands thoroughly with soap and water after handling this product, and before eating or smoking. Wash contaminated clothing thoroughly before reuse. Safety showers and eye stations should be available to employees.

OTHER STORAGE AND HANDLING REQUIREMENTS: Observe label precautions. Store in a cool, well-ventilated liquid storage area. Keep away from moisture, heat, sparks, and open flames. Use non-sparking tools. Use only with adequate ventilation. Avoid contact with eyes, skin and clothes. Avoid breathing vapor. At storage temperatures above 100 degrees F, this product may slowly polymerize.

PROTECTIVE MEASURES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Do not weld, heat or drill on or near containers. Wear appropriate personal protective equipment when working on contaminated equipment if the ingredients exceed the TLV. Do not sand, flame cut, braze or weld dry coating without a NIOSH/MSHS approved respirator, as welding fumes may be harmful.

The information contained herein is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes.

MATERIAL SAFETY DATA SHEET

DATE OF PREPARATION: 09/27/97
 DATE OF LAST REVISION: 09/17/01
 MANUFACTURER'S CODE: MC-FERROMASTIC 2.8

SECTION I: GENERAL

MANUFACTURER'S NAME AND ADDRESS: WASSER HIGH-TECH COATINGS, INC.
 1004 W. JAMES STREET, SUITE 100, KENT, WA 98032
 INFORMATION PHONE NUMBER: 253-850-2967
 EMERGENCY PHONE NUMBER: CHEMTREC 800-424-9300
 CHEMICAL FAMILY: MOISTURE-CURE, POLYURETHANE PAINT
 TRADE NAME: WASSER MC-FERROMASTIC
 HMIS RATINGS: H-2,F-3,R-1

SECTION II: HAZARDOUS INGREDIENTS

INGREDIENTS	%WT	CAS NUMBER	EXPOSURE LIMITS TLV*
POLYURETHANE PREPOLYMER	20-30	Proprietary	0.02ppm ceiling OSHA PEL
HIGH FLASH NAPHTHA	05-15	64742-95-6	50ppm-Manufacturer
METHYL n-AMYL KETONE	0-10	110-43-0	50ppm - TW8 ACGIH 100ppm - TW8 OSHA
METHYLISOBUTYLKETONE	0-10	108-10-1	50ppm TWA OSHA 75ppm OSHA STEL 50ppm - TWA ACGIH 75ppm ACGIH STEL
XYLENE	0-10	1330-20-7	100ppm - TWA OSHA 150ppm OSHA STEL 100ppm - TWA ACGIH 150ppm ACGIH STEL

SECTION III: PHYSICAL DATA

BOILING POINT: 260°F; 127°C
 APPROX. WEIGHT PER GALLON: 12 LBS.; 1.4 g/cm³
 EVAPORATION RATE: SLOWER THAN ETHER
 VAPOR DENSITY: HEAVIER THAN AIR
 % VOLATILE (VOLUME): 38 (APPRX)
 VOC: LESS THAN 2.8 LBS/GAL; 340g/L
 APPEARANCE AND ODOR: BROWN COLORED LIQUID WITH AROMATIC SOLVENT ODOR
 SOLUBILITY IN WATER: NONE

SECTION IV: FIRE AND EXPLOSION INFORMATION

FLASH POINT: 83° F; 29° C, CLOSED CUP

EXTINGUISHING MEDIA: DRY CHEMICAL, FOAM, CARBON DIOXIDE, WATER SPRAY

SPECIAL FIREFIGHTING PROCEDURES: Wear self-contained breathing apparatus (SCBA), with a full-face piece, operated in the positive-pressure mode. Full protective clothing such as rubber gloves, boots, etc. should be worn by firefighters. No skin should be exposed. Clear fire area of unprotected personnel. Water from fog nozzles may be useful to cool closed containers to prevent pressure build-up.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Vapor is heavier than air. Under conditions of stagnant air, vapors can build up and travel a considerable distance along the ground to an ignition source, which may result in a flashback to the source of the vapors, or an explosion. Do not use or store near open flame, heat, sparks, electrical equipment or hot surfaces. Use only in well-ventilated areas. Closed containers may explode when exposed to extreme heat or burst when contaminated with water (CO₂ evolved). During a fire, isocyanate vapors and other irritating, highly toxic gases may be generated by thermal decomposition or combustion.

SECTION V: FIRST AID AND HEALTH HAZARD INFORMATION**EMERGENCY FIRST AID:**

INGESTION: Gastro-intestinal distress. In the unlikely event of ingestion, call a physician immediately with a list of the ingredients.

SKIN: Remove heavily contaminated clothing. Wash affected skin thoroughly with soap and water.

EYE: Flush with water for at least 15 minutes and consult a physician. If irritation continues, consult a physician.

INHALATION: This is an industrial paint. The primary hazard is organic solvent. Inhalation of reactive polyurethane is unlikely unless spraying, then the hazard is spray dust. An inhalation above TLV can occur when spraying or painting in a confined space without respiratory protection. Remove exposed person to fresh air. Treat for exposure to organic solvent. Give mouth to mouth then oxygen if breathing has stopped. Contact a physician. Asthmatic type symptoms may develop and persist for 12-24 hours if exposed to excessive spray dust or fumes without respiratory protection. Treatment is symptomatic.

HEALTH HAZARD INFORMATION: SYMPTOMS OF OVER EXPOSURE:

INHALED: Nasal and respiratory tract irritation. Breathing solvent vapors at concentrations in air that exceed 80ppm can cause narcosis and central nervous system effects including dizziness, loss of coordination, drowsiness, headaches, confusion, fatigue, nausea, loss of appetite and/or loss of consciousness. Sensitized individuals may experience chest tightness, wheezing, coughing and/or shortness of breath. These symptoms may not appear for hours and may persist for 4-24 hours.

CONTACT WITH SKIN: Overexposure may cause severe irritation. Skin irritation to isocyanates and organic solvents may cause allergic dermatitis in individuals with prior sensitization. Exposure to dried paint or dust is not hazardous.

CONTACT WITH EYES: May cause severe irritation.

SWALLOWED: Any ingestion is harmful resulting in burning sensation in the mouth and stomach accompanied by abdominal distress.

HEALTH EFFECTS OR RISKS FROM UNPROTECTED EXPOSURE:

ACUTE: Prolonged unprotected breathing of solvent vapor or spray may cause eye, nose, respiratory tract and/or skin irritation. Allergic skin or respiratory reaction may occur in some individuals. Narcotic in high concentrations. Headache, nausea, confusion, reversible eye damage, abdominal pain, fatigue and loss of consciousness may occur.

CHRONIC: Long term unprotected exposure may lead to muscular weakness, confusion, impaired coordination, liver damage, kidney damage, dermatitis, mucous membrane damage, pulmonary edema, anorexia and/or blood disorders. Large decreases in lung function may occur with chronic overexposure to isocyanates.

Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage.

SECTION V, cont.

As a result of previous unprotected overexposure, certain individuals may develop isocyanate sensitization (chemical asthma) which will cause them to react to a later exposure to isocyanates well below the TLV. Sensitized individuals may show symptoms similar to individuals who show sensitization to specific dusts, animal furs, and other irritants if re-exposed to this product. This lung sensitivity can reappear in a sensitized individual if re-exposed. Skin sensitization can also result from overexposure.

Laboratory studies with rats have shown that petroleum distillates cause kidney damage and kidney or liver tumors. Several studies evaluating petroleum workers have not shown significant increases of kidney damage nor kidney or liver tumors. Prolonged and repeated unprotected breathing of spray mists and/or dusts over a period of years may cause lung disease.

This product contains no cancer agent found on any list.

SECTION VI: REACTIVITY DATA

CONDITIONS TO AVOID: Avoid heat, sparks, open flames and other sources of ignition.

INCOMPATIBILITY (MATERIALS TO AVOID): Mixing with water, alcohol, amines, strong acids and bases, oxidizing agents and surface active materials may cause reaction or gelling.

HAZARDOUS DECOMPOSITION PRODUCTS: Toxic gases and vapors including carbon monoxide, carbon dioxide, oxides of nitrogen, traces of HCN, isocyanates and other unidentified organic compounds.

CONDITIONS TO AVOID: Combining or mixing with water or other materials that react with isocyanates may cause gelation or premature reaction in the container.

SECTION VII: SPILL, LEAK, AND DISPOSAL INFORMATION:

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: This material is paint. Minor spills or leaks in well-ventilated areas cause no hazard. Major spills in confined areas should be treated with care. Avoid all sources of ignition if solvent vapors are excessive or the spill is confined to a closed van or confined space. Persons not wearing protective equipment should avoid the area until solvent vapors have subsided. Avoid allowing spilled material to leak into any flowing water source. Material spilled on the ground can be contained and collected with absorbent. There is no danger of material penetrating into ground water if it is contained. Solvent evaporation will occur in spilled material if left in open ventilation leaving a solid stable non-hazardous residue. Dried material can be disposed of in landfill. Semi-dry and liquid should be collected and placed in sealed salvage containers or allowed to dry by evaporation in a well-ventilated area.

WASTE DISPOSAL PROCEDURES: Spilled product that is not a thin film dried paint must be disposed of as a hazardous solid waste according to Resource Conservation and Recovery Act regulations. Preferred method of disposal is incineration.

SECTION VIII: EMPLOYEE PROTECTION INFORMATION:

Precautions must be taken so those persons handling this material do not breathe the vapors above the TLV, or have it contact the skin or eyes. In spray operations, protection must be afforded against exposure to both vapor and spray mist.

EYE PROTECTION: Liquid chemical goggles. Vapor resistant goggles should be worn when contact lenses are in use. In a splash hazard environment: goggles or a full face-shield should be used.

SKIN PROTECTION: Permeation resistant gloves (butyl rubber, nitrile rubber, polyvinyl alcohol). Cover as much of the exposed skin area as possible with appropriate clothing. If skin creams are used, keep the area covered by the cream to a minimum.

RESPIRATOR: This product contains polymeric reactive polyurethane prepolymers. Due to the high molecular weight and low vapor pressure it is extremely unlikely that measurable reactive polymer can get into the vapor phase during normal mixing, stirring, brushing, or rolling applications; however, during spraying in confined spaces the spray mist particles may reach a hazardous level, even if the vapor phase does not contain hazardous levels. **Since this product contains organic solvent it is required to wear an organic vapor cartridge filter during stirring, brushing, rolling or inspection of drying paint. During spraying or application in confined spaces it is required to wear a full fresh air supplied respirator. This product will generally not show reactive isocyanate at levels above the TLV in the vapor phase, even during spray operations; however, during spray operations spray particles will contain reactive prepolymer at a hazardous level. These particles may penetrate a canister respirator if improperly fit or if no equipped with a HEPA prefilter. Therefore always wear a full fresh air supplied respirator during spray operations when airborne spray dust is present in hazardous levels.**

GLOVES: Skin contact should be minimized by wearing solvent impermeable gloves made of neoprene or nitrile rubber.

OTHER PROTECTIVE CLOTHING AND EQUIPMENT: Appropriate protective clothing necessary to prevent repeated or prolonged skin contact should be worn. Solvent resistant boots should be worn where spill or splashing can occur. If barrier creams are used, keep the area that is protected only by the cream, to a minimum.

HYGIENIC WORK PRACTICES: Wash hands thoroughly with soap and water after handling this product, and before eating or smoking. Wash contaminated clothing thoroughly before reuse. Safety showers and eye stations should be available to employees.

OTHER STORAGE AND HANDLING REQUIREMENTS: Observe label precautions. Store in a cool, well-ventilated liquid storage area. Keep away from moisture, heat, sparks, and open flames. Use non-sparking tools. Use only with adequate ventilation. Avoid contact with eyes, skin and clothes. Avoid breathing vapor. At storage temperatures above 100 degrees F, this product may slowly polymerize.

PROTECTIVE MEASURES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Do not weld, heat or drill on or near containers. Wear appropriate personal protective equipment when working on contaminated equipment if the ingredients exceed the TLV. Do not sand, flame cut, braze or weld dry coating without a NIOSH/MSHS approved respirator, as welding fumes may be harmful.

The information contained herein is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes.

MATERIAL SAFETY DATA SHEET

DATE OF PREPARATION: 09/27/97
 DATE OF LAST REVISION: 09/17/01
 MANUFACTURER'S CODE: MC-FERROX A 2.8

SECTION I: GENERAL

MANUFACTURER'S NAME AND ADDRESS: WASSER HIGH-TECH COATINGS, INC.
 1004 WEST JAMES STREET, SUITE 100, KENT, WA 98032
 INFORMATION PHONE NUMBER: 253-850-2967
 EMERGENCY PHONE NUMBER: CHEMTREC 800-424-9300
 CHEMICAL FAMILY: MOISTURE-CURE, POLYURETHANE PAINT
 TRADE NAME: WASSER MC-FERROX A
 HMIS RATINGS: H-2,F-3,R-1

SECTION II: HAZARDOUS INGREDIENTS

INGREDIENTS	%WT	CAS NUMBER	EXPOSURE LIMITS TLV
POLYURETHANE PREPOLYMER	25-50	Proprietary	0.005ppm TWA OSHA
HIGH FLASH NAPHTHA	05-15	64742-95-6	50ppm-Manufacturer
METHYL n-AMYL KETONE	02-12	110-43-0	50ppm - TW8 ACGIH
			100ppm - TW8 OSHA
METHYLISOBUTYLKETONE	0-10	108-10-1	50ppm - TW8 OSHA
			75ppm OSHA STEL
			50ppm - TW8 ACGIH
			75ppm ACGIH STEL
XYLENE	0-10	1330-20-7	100ppm - TWA OSHA
			150ppm OSHA STEL
			100ppm - TWA ACGIH
			150ppm ACGIH STEL

SECTION III: PHYSICAL DATA

BOILING POINT: 230°F; 110°C
 APPROX. WEIGHT PER GALLON: 13 LBS.; 1.6g/cm³
 EVAPORATION RATE: SLOWER THAN ETHER
 VAPOR DENSITY: HEAVIER THAN AIR
 % VOLATILE (VOLUME): 38 (APPRX)
 VOC: LESS THAN 2.8 LBS/GAL; 340g/L
 APPEARANCE AND ODOR: COLORED LIQUID WITH AROMATIC SOLVENT ODOR
 SOLUBILITY IN WATER: NONE

SECTION IV: FIRE AND EXPLOSION INFORMATION

FLASH POINT: 78°F; 25°C
 EXTINGUISHING MEDIA: DRY CHEMICAL, FOAM, CARBON DIOXIDE, WATER SPRAY

SPECIAL FIREFIGHTING PROCEDURES: Wear self-contained breathing apparatus (SCBA), with a full-face piece, operated in the positive-pressure mode. Full protective clothing such as rubber gloves, boots, etc. should be worn by firefighters. No skin should be exposed. Clear fire area of unprotected personnel. Water from fog nozzles may be useful to cool closed containers to prevent pressure build-up.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Vapor is heavier than air. Under conditions of stagnant air, vapors can build up and travel a considerable distance along the ground to an ignition source, which may result in a flashback to the source of the vapors, or an explosion. Do not use or store near open flame, heat, sparks, electrical equipment or hot surfaces. Use only in well-ventilated areas. Closed containers may explode when exposed to extreme heat or burst when contaminated with water (CO₂ evolved). During a fire, isocyanate vapors and other irritating, highly toxic gases may be generated by thermal decomposition or combustion.

SECTION V: FIRST AID AND HEALTH HAZARD INFORMATION**EMERGENCY FIRST AID:**

INGESTION: Gastro-intestinal distress. In the unlikely event of ingestion, call a physician immediately with a list of the ingredients.

SKIN: Remove heavily contaminated clothing. Wash affected skin thoroughly with soap and water.

EYE: Flush with water for at least 15 minutes and consult a physician. If irritation continues, consult a physician.

INHALATION: This is an industrial paint. The primary hazard is organic solvent. Inhalation of reactive polyurethane is unlikely unless spraying, then the hazard is spray dust. An inhalation above TLV can occur when spraying or painting in a confined space without respiratory protection. Remove exposed person to fresh air. Treat for exposure to organic solvent. Give mouth to mouth then oxygen if breathing has stopped. Contact a physician. Asthmatic type symptoms may develop and persist for 12-24 hours if exposed to excessive spray dust or fumes without respiratory protection. Treatment is symptomatic.

HEALTH HAZARD INFORMATION: SYMPTOMS OF OVER EXPOSURE:

INHALED: Nasal and respiratory tract irritation. Breathing solvent vapors at concentrations in air that exceed 80ppm can cause narcosis and central nervous system effects including dizziness, loss of coordination, drowsiness, headaches, confusion, fatigue, nausea, loss of appetite and/or loss of consciousness. Sensitized individuals may experience chest tightness, wheezing, coughing and/or shortness of breath. These symptoms may not appear for hours and may persist for 4-24 hours.

CONTACT WITH SKIN: Overexposure may cause severe irritation. Skin irritation to isocyanates and organic solvents may cause allergic dermatitis in individuals with prior sensitization. Exposure to dried paint or dust is not hazardous.

CONTACT WITH EYES: May cause severe irritation.

SWALLOWED: Any ingestion is harmful resulting in burning sensation in the mouth and stomach accompanied by abdominal distress.

HEALTH EFFECTS OR RISKS FROM UNPROTECTED EXPOSURE:

ACUTE: Prolonged unprotected breathing of solvent vapor or spray may cause eye, nose, respiratory tract and/or skin irritation. Allergic skin or respiratory reaction may occur in some individuals. Narcotic in high concentrations. Headache, nausea, confusion, reversible eye damage, abdominal pain, fatigue and loss of consciousness may occur.

CHRONIC: Long term unprotected exposure may lead to muscular weakness, confusion, impaired coordination, liver damage, kidney damage, dermatitis, mucous membrane damage, pulmonary edema, anorexia and/or blood disorders. Large decreases in lung function may occur with chronic overexposure to isocyanates.

Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage.

SECTION V, cont.
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Page 1 of 2

As a result of previous unprotected overexposure, certain individuals may develop isocyanate sensitization (chemical asthma) which will cause them to react to a later exposure to isocyanates well below the TLV. Sensitized individuals may show symptoms similar to individuals who show sensitization to specific dusts, animal furs, and other irritants if re-exposed to this product. This lung sensitivity can reappear in a sensitized individual if re-exposed. Skin sensitization can also result from overexposure.

Laboratory studies with rats have shown that petroleum distillates cause kidney damage and kidney or liver tumors. Several studies evaluating petroleum workers have not shown significant increases of kidney damage nor kidney or liver tumors. Prolonged and repeated unprotected breathing of spray mists and/or dusts over a period of years may cause lung disease.

This product contains no cancer agent found on any list.

SECTION VI: REACTIVITY DATA

CONDITIONS TO AVOID: Avoid heat, sparks, open flames and other sources of ignition.

INCOMPATIBILITY (MATERIALS TO AVOID): Mixing with water, alcohol, amines, strong acids and bases, oxidizing agents and surface active materials may cause reaction or gelling.

HAZARDOUS DECOMPOSITION PRODUCTS: Toxic gases and vapors including carbon monoxide, carbon dioxide, oxides of nitrogen, traces of HCN, isocyanates and other unidentified organic compounds.

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WASTE DISPOSAL PROCEDURES: Spilled product that is not a thin film dried paint must be disposed of as a hazardous solid waste according to Resource Conservation and Recovery Act regulations. Preferred method of disposal is incineration.

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EYE PROTECTION: Liquid chemical goggles. Vapor resistant goggles should be worn when contact lenses are in use. In a splash hazard environment goggles or a full face shield should be used.

SKIN PROTECTION: Permeation resistant gloves (butyl rubber, nitrile rubber, polyvinyl alcohol). Cover as much of the exposed skin area as possible with appropriate clothing. If skin creams are used, keep the area covered by the cream to a minimum.

RESPIRATOR: This product contains polymeric reactive polyurethane prepolymers. Due to the high molecular weight and low vapor pressure it is extremely unlikely that measurable reactive polymer can get into the vapor phase during normal mixing, stirring, brushing, or rolling applications; however, during spraying in confined spaces the spray mist particles may reach a hazardous level, even if the vapor phase does not contain hazardous levels. **Since this product contains organic solvent it is required to wear an organic vapor cartridge filter during stirring, brushing, rolling or inspection of drying paint. During spraying or application in confined spaces it is required to wear a full fresh air supplied respirator. This product will generally not show reactive isocyanate at levels above the TLV in the vapor phase, even during spray operations; however, during spray operations spray particles will contain reactive prepolymer at a hazardous level. These particles may penetrate a canister respirator if improperly fit or if not equipped with a HEPA prefilter. Therefore always wear a full fresh air supplied respirator during spray operations when airborne spray dust is present in hazardous levels.**

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HYGIENIC WORK PRACTICES: Wash hands thoroughly with soap and water after handling this product, and before eating or smoking. Wash contaminated clothing thoroughly before reuse. Safety showers and eye stations should be available to employees.

OTHER STORAGE AND HANDLING REQUIREMENTS: Observe label precautions. Store in a cool, well-ventilated liquid storage area. Keep away from moisture, heat, sparks, and open flames. Use non-sparking tools. Use only with adequate ventilation. Avoid contact with eyes, skin and clothes. Avoid breathing vapor. At storage temperatures above 100 degrees F, this product may slowly polymerize.

PROTECTIVE MEASURES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Do not weld, heat or drill on or near containers. Wear appropriate personal protective equipment when working on contaminated equipment if the ingredients exceed the TLV. Do not sand, flame cut, braze or weld dry coating without a NIOSH/MSHS approved respirator, as welding fumes may be harmful.

The information contained herein is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes.

REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.					
1. REPORT DATE (DD-MM-YYYY) 3-2003		2. REPORT TYPE Final		3. DATES COVERED (From - To)	
4. TITLE AND SUBTITLE Overcoating of Lead-based Paint on Steel Structures: Cost and Performance Report				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Timothy D. Race, Ashok Kumar, Robert A. Weber, and L.D. Stephenson				5d. PROJECT NUMBER 063728A	
				5e. TASK NUMBER 002	
				5f. WORK UNIT NUMBER CFM B101	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Engineer Research and Development Center (ERDC) Construction Engineering Research Laboratory (CERL) PO Box 9005 Champaign, IL 61826-9005				8. PERFORMING ORGANIZATION REPORT NUMBER ERDC/CERL TR-03-5	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Assistant Chief of Staff for Installation Management 600 Army Pentagon Washington, DC 20310-0600				10. SPONSOR/MONITOR'S ACRONYM(S) ACSIM-FDF	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.					
13. SUPPLEMENTARY NOTES Copies are available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.					
14. ABSTRACT Hazardous lead-based paint (LBP) has been used extensively on all types of Department of Defense steel structures and steel components. The removal of LBP is generally performed by abrasive blasting or by water jetting. Containment and disposal of surface preparation debris, worker protection, and other regulatory compliance costs combine to make removal of LBP very expensive. The Environmental Security Technology Certification Program (ESTCP) project reported here demonstrated the overcoating process, which may be defined as the practice of painting over existing coatings as a means of extending service life. Overcoating offers the benefit of maximizing the economic life of existing LBP coatings while minimizing present expenditures and reducing worker exposure and hazardous waste generation. Demonstration of the overcoat process was performed on a water tank at Fort Campbell, KY and a railroad bridge at Holston Army Ammunition Plant (HAAP), Kingsport, TN. The installed cost of overcoating on the simple structure (water tank) was estimated at \$1.55/sq ft. The installed cost for overcoating on the complex structure (railroad bridge) was estimated at \$2.83/sq ft. By comparison, the cost of deleading and installing a new paint system is \$5 to \$18/sq ft with an average cost of \$8/sq ft.					
15. SUBJECT TERMS lead-based paint, environmental compliance, steel structures, overcoating, cost analysis, Environmental Security Technology Certification Program (ESTCP)					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Dr. Ashok Kumar
Unclassified	Unclassified	Unclassified	SAR	50	19b. TELEPHONE NUMBER (include area code) 217-373-7235